BURNS McDONNELL

Preliminary Engineering Report

City of Chattanooga

Citico Pump Reliability Improvements

City Project No. W-16-013-101
BMcD Project No. 95307

Revision 0
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Preliminary Engineering Report

prepared for

City of Chattanooga
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prepared by

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LIST OF ABBREVIATIONS

Abbreviation	Term/Phrase/Name
A/C	Air Conditioning
ATS	Automatic Transfer Switch
BMcD	Burns & McDonnell Engineering Company
CFM	Cubic Feet Per Minute
CO	Carbon Monoxide
CSOTF	Combined Sewer Overflow Treatment Facility
DIP	Ductile Iron Pipe
EBPS	Emergency Backup Pump Station
EPB	Electric Power Board of Chattanooga
FM	Force Main
FRP	Fiber Reinforced Plastic
GIS	Geographic Information Systems
GPM	Gallons per Minute
H_2S	Hydrogen Sulfide
HP	Horsepower
HVAC	Heating, Ventilation, and Air Conditioning
I/O	Input/Output
IWH	Instantaneous Water Heater
KW	Kilowatt
KWHr	Kilowatt-hour
LEL	Lower Explosive Limit

Abbreviation	Term/Phrase/Name
MBWWTP	Moccasin Bend Waste Water Treatment Plant
MCC	Motor Control Center
MGD	Million Gallons per Day
MSA	Mine Safety Appliance
NEC	National Electric Code
NFPA	National Fire Protection Association
NPSH	Net Positive Suction Head
O_2	Oxygen
O&M	Operations and Maintenance
PLC	Programmable Logic Controller
PS	Pump Station
PVC	Poly-vinyl Chloride
RPM	Revolutions Per Minute
SCADA	Supervisory Control and Data Acquisition
TDEC	Tennessee Department of Environment and Conservation
TDH	Total Dynamic Head, in feet
TVA	Tennessee Valley Authority
USACOE	United States Army Corps of Engineers
VFD	Variable Frequency Drive
WWFM	Wastewater Force Main

1.0 EXECUTIVE SUMMARY

Citico Pump Station is a sanitary and combined sewer pump station located at 929 Riverside Drive in Chattanooga, Tennessee, one of the larger pump stations within the City of Chattanooga's sewer system. The pump station collects sewer flows from influent gravity sewers, screens the flow to remove debris and rags, and pumps the flow through two force mains under the Tennessee River to a discharge manhole structure on the North side of the river. The discharged flows are then conveyed by gravity through sewer trunk lines to the Moccasin Bend Waste Water Treatment Plant.

The City of Chattanooga engaged Burns & McDonnell Engineering Company to execute a project to improve the reliability of the station to reduce the likelihood of sewer overflows when Citico Pump Station is down for an emergency event or major maintenance. Reliability improvements will include the addition of an emergency backup pump station to operate in the event of an emergency at Citico Pump Station, a permanent backup generator for onsite power redundancy, preparations for a second electric utility service to the site to serve as an alternate source in the future, electrical equipment upgrades to eliminate single points of failure, and a new odor control system.

This Preliminary Engineering Report (PER) addresses the design of an Emergency Backup Pump Station, electrical reliability improvements, the odor control system, and the construction sequencing which will bring the improvements into service while minimizing down-time or extended bypass pumping of the existing pump station. The Emergency Backup Pump Station will be located upstream of the existing Citico Pump Station and have a capacity of 45 MGD. Mechanical grinders will be utilized for solids maceration upstream of submersible pumps, which will convey the flow across the river via the existing force mains. A permanent on-site diesel generator will be installed to provide a redundant electrical service, and cabling and site planning allocations will be made to accommodate a future second electrical service to the site from the power utility. A new service entrance switchgear and distribution switchboard will be installed at the station to complete the electrical reliability improvements. The odor control system will be replaced and upgraded. Construction will be sequenced such that the installation of new equipment is completed without disrupting any services or flows to the existing station. When the improvements are ready to be brought online, pre-planned downtime of the existing station will be required to make final electrical and piping connections. It is the intent of the design that down-time of the existing station be kept to a minimum, and wastewater flow will be diverted to the new Emergency Backup Pump Station while the existing station is down for final construction connections.

2.0 DESIGN OBJECTIVES

2.1 Introduction

In 2015, Burns and McDonnell Engineering Company, Inc. (BMcD) conducted an assessment of Citico Pump Station to determine improvements which could be made to increase reliability, add redundancy, and improve operational efficiency. Following the release of the Pump Station Assessment Technical Memorandum in June of 2015, the City of Chattanooga engaged BMcD to execute a project to improve the reliability of the station by adding an Emergency Backup Pump Station (EBPS), a backup generator, new electrical switchgear and switchboard, and a new odor control system.

The intent of the EBPS, located immediately upstream of the existing Citico Pump Station, is to reduce the likelihood of sewer overflows by operating when Citico is down for an emergency event or major maintenance. During emergency events, wastewater will divert by passing over a weir into the EBPS as the influent water level rises above the normal high water level of the Citico Pump Station. The EBPS pumps will start automatically as the wet well level increases. For a major maintenance event, a slide gate in the diversion chamber can be closed to completely shut off Citico and divert all flow to the EBPS. The minimum target capacity of the EBPS is 80 percent of Citico's historical dry-weather flow.

Electrical reliability improvements at the Citico site will be constructed to provide permanent on-site emergency backup power generation, make provisions for a second site electrical utility feed, and eliminate single points of failure in the electrical system. The existing odor control system will be replaced with a new, larger system having capacity to treat both the existing Citico pump station and the new EBPS.

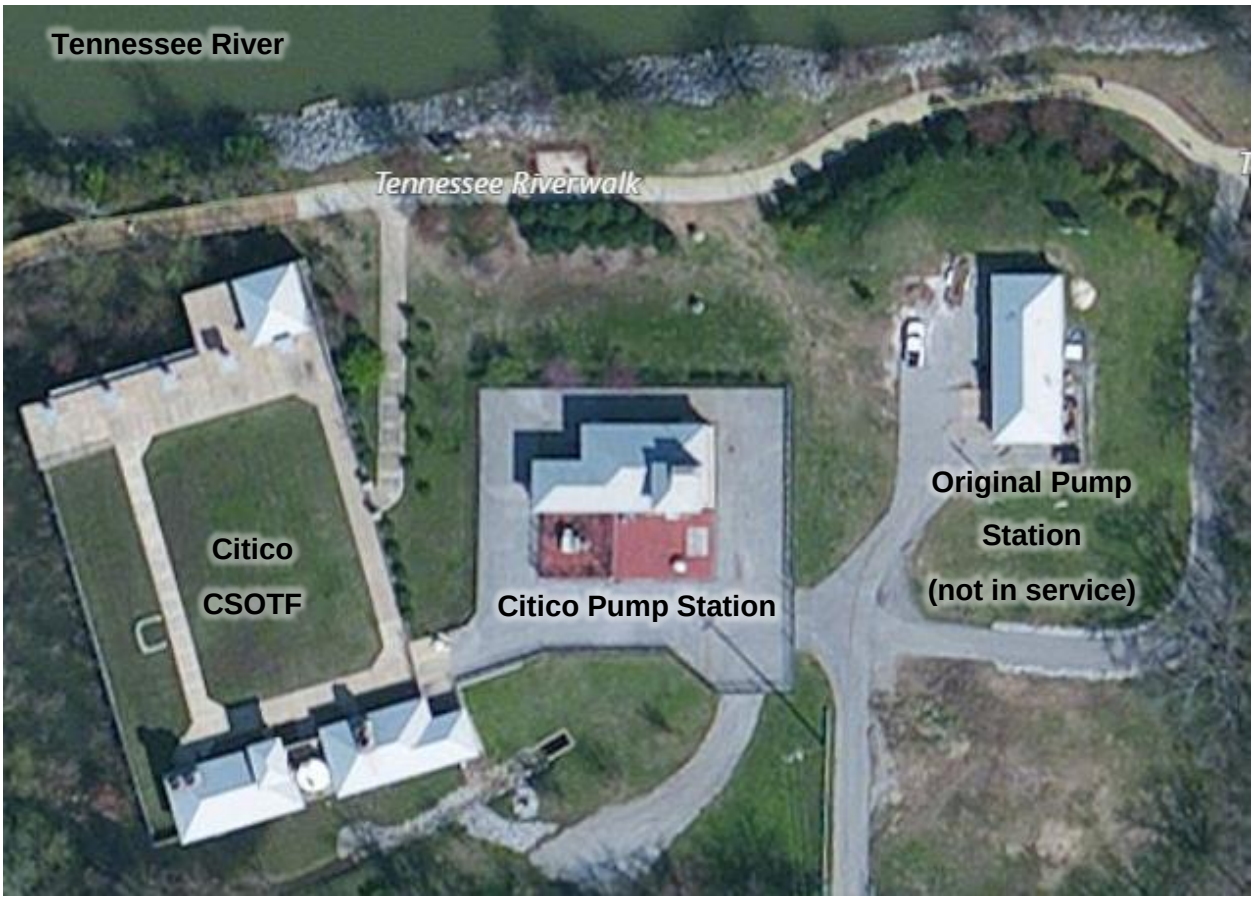
2.2 Existing Conditions

The existing Citico Pump Station has been in operation since the 1991. It was constructed as an upgrade and replacement of the original Citico Pump Station (Contract 10), which was built in the latter part of the 1950s. The original pump station conveyed wastewater flow from the south side of the Tennessee River to the north side via a 30-inch concrete pressure pipe force main (Contract 8) built around the same time. Modifications were made to the station in 1976, and it remained in operation until the early 1990s, when it was decommissioned and the building and site were turned over to the Parks Division of the Public Works Department. The current Citico Pump Station (Contract No. 37-C) was designed in 1989 and subsequently built, with a capacity of approximately 119 MGD. Figure 2-1 shows the arrangement of the existing Citico site. A new 48-inch ductile iron pipe (DIP) force main was constructed at the same time (Contract No. 37-B) to convey wastewater from the new Citico Pump Station across the river in an

alignment approximately parallel to the existing 30-inch pipe. The current station utilizes both the original 30-inch and the newer 48-inch force main to convey wastewater under the river, which discharge into a junction box and an 84-inch reinforced concrete pipe (RCP) interceptor sewer that carries the flow to the Moccasin Bend Waste Water Treatment Plant (MBWWTP).

In 1999, a Combined Sewer Overflow Treatment Facility (CSOTF) was designed and subsequently constructed adjacent to Citico Pump Station. It captures wet-weather combined sewer events from the downtown area and provides primary screening and treatment before discharging to the Tennessee River. The CSOTF effluent pump project, under construction as of February 2017, will add pumps in the effluent chamber of the CSOTF to allow it to operate when the Tennessee River water elevation is too high for it to operate by gravity. When flows at Citico are less than station capacity, wastewater from the combined interceptor bypasses the CSOTF and flows to the Citico Pump Station which conveys it across the river for full treatment at the MBWWTP. The overall Citico facility is largely automated, and operators typically check on the facility once a week. Maintenance records of the facility are stored in a work order system at the MBWWTP.

Figure 2-1: Citico Pump Station Site *(source Bing Maps)*



Citico is arranged in a wet- and dry-well configuration, with four 450 HP horizontal centrifugal pumps rated for 27,500 GPM at 50 feet of head with Variable Frequency Drives (VFDs). Based on three duty pumps and one standby, Citico is rated for a firm capacity of approximately 118.8 MGD. Influent enters the station through a 72-inch RCP interceptor line from the north wall of the wet well. A wall-mounted slide gate in the wet well serves to shut off the 72-inch line flow into the station, however there is concern by City staff that due to extensive corrosion of the frame and anchors this gate is no longer safe to operate and may fail in the event of an attempted closure. The 72-inch gate is currently in the open position and, by City staff recollection, has never been closed. A new motor operator, installed on this gate in 2016, occupies a space of the floor within the existing odor control equipment room above the wet well. A 36-inch influent line also enters the wet well from the east wall and has a similar slide gate. City staff believes this 36-inch gate, currently closed, is inoperable and that the upstream line is no longer in service. Research of as-built construction drawings indicate that the 36-inch line may have been used, most recently, as a temporary bypass during the construction of the CSOTF project and subsequently abandoned.

Citico is fed by a single utility feeder at 12kV from Electric Power Board of Chattanooga (EPB). That utility feed enters a 2500kVA transformer, which steps-down from utility voltage to 480Y/277V. There are three services tapped from this transformer. The pump station was initially the only facility fed from this transformer. The CSOTF was added as a second tap on the secondary side of the transformer. The CSOTF effluent pump project, under construction as of February 2017, was designed as a third tap on the transformer in anticipation of this project design. The tap that feeds the pump station switchboard is a 3,000A service. The tap that will feed CSOTF Effluent Pumps is an 800A service. The tap that feeds the CSOTF Motor Control Center is a 600A service.

The pump station switchboard is a Cutler-Hammer Pow-R-Line C, 3000A, 480Y/277V, 3-phase, 4 wire, 65kAIC switchboard and has five feeders that it supplies. Four are 900A feeders that provide power to the four 450 HP pump station pumps. The fifth 600A feeder serves the pump station MCC.

A City-owned, trailer-mounted, 1,500kW generator can be parked at Citico and connected to the main pump station switchboard bus to provide backup power to the pump station. The generator cables run to a quick connect switchgear section outside of the pump station. That outdoor switchgear is connected to the bus of the interior pump station switchboard. The main breaker on the outdoor quick connect switchgear is interlocked with the main breaker on the interior pump station switchboard with a key interlock. The key interlock prevents both main breakers from being closed at the same time. This generator is not capable of providing backup power to the CSOTF.

The odor control system currently installed within the Citico pump station has a capacity of 9,600 cfm at 20 HP. The system uses a carbon media which requires replacement approximately every eight months. Supply air for the odor control system enters the wet well from the plenum space in the existing mechanical room and is exhausted through the chimney next to the elevator shaft. The equipment for the odor control system is installed within the pump station building in a room which opens to the screening room.

2.3 Emergency Backup Pump Station

2.3.1 Existing Flow Data and EBPS Pumping Capacity

Tabulated effluent flow data from Citico was provided by the City to Burns & McDonnell for a five-year period from 2011 to 2016. Rainfall data from the nearby Lovell Airport (NOAA Station ID 401656) was acquired and correlated with the pump station flow data in order to separate the dataset into dry- and wet-weather periods. Figures 2-2 and 2-3 show exceedance curves for dry-weather flow and for all-weather total daily flow, respectively, for the Citico pump station during the five-year period for which data was analyzed. From June 2011 to June 2016, the maximum daily flow was 108 MGD. At the direction of the City the target for emergency backup pumping capacity was to capture a maximum flow representing a 0.2 probability of exceedance, or 80 percent of the maximum flow during dry weather. 40 MGD was preliminarily targeted as a design capacity, representing a 0.23 dry-weather flow probability of exceedance, however a final decision was made to increase the design capacity to a more conservative 45 MGD, representing 0.08 dry-weather flow probability of exceedance or 92 percent of maximum flow during dry weather. 45 MGD also represents a 0.28 total flow probability of exceedance for all-weather total flow. Two duty pumps with VFDs, rated at 22.5 MGD each, will be included in the design.

Figure 2-2: Dry-Weather Flow Probability of Exceedance (2011 to 2016)

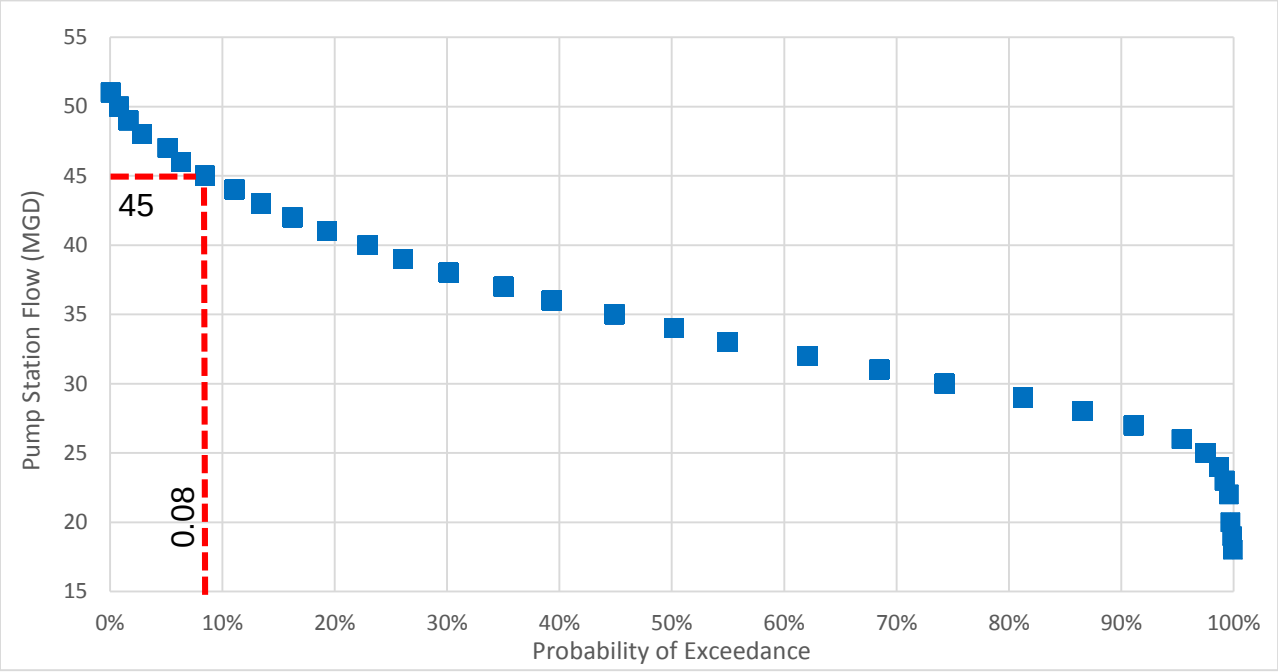
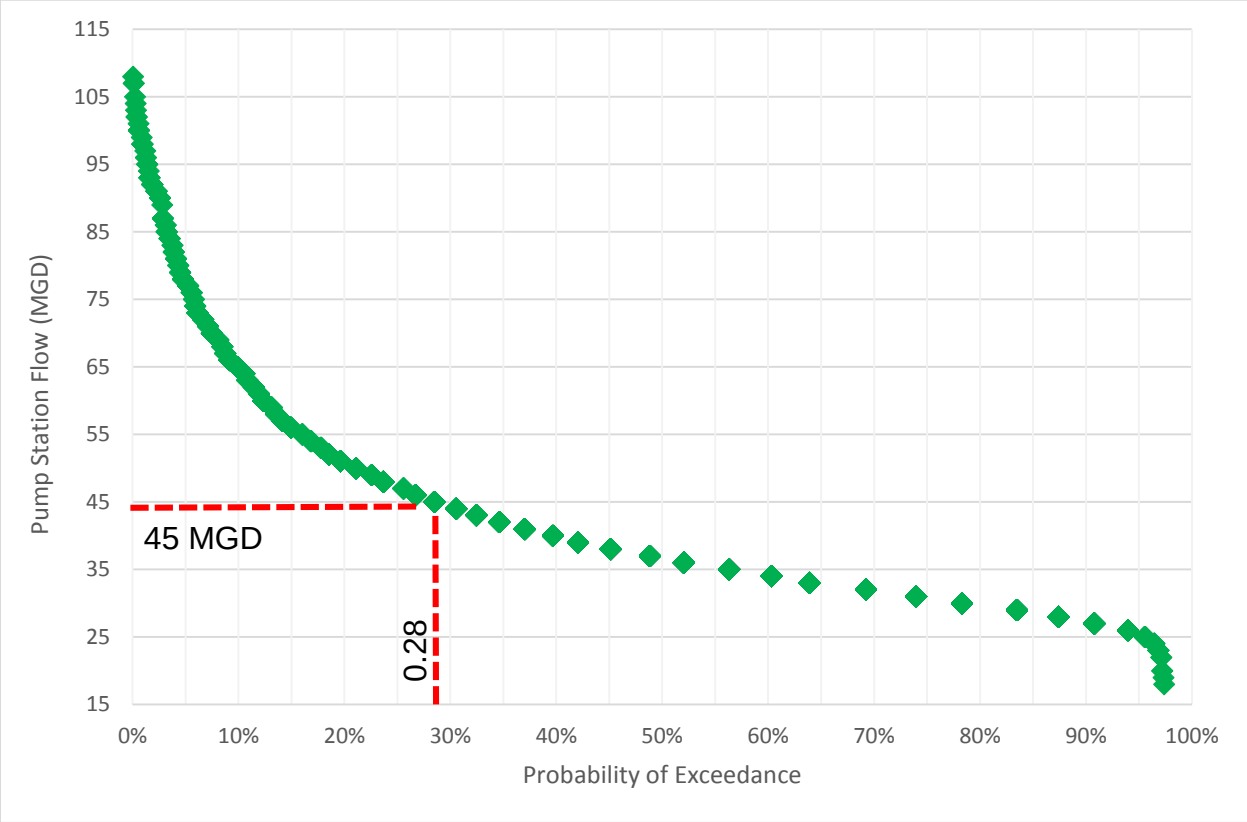


Figure 2-3: All-Weather Total Flow Probability of Exceedance (2011 to 2016)



2.3.2 Pump Station Operating Levels

The existing Citico Pump Station wet well operates between a low water level elevation of 624.75 feet and a high-high alarm level of 637.75 feet, according to current operational schemes. The floor of the existing wet well is at an elevation of 618.75 feet and the pump intake centerline is at an elevation of 623.79 feet. The normal set-point in the wet well is 9 feet (627.75) for the lead pump control, and pumps run in a Lead-Lag1-Lag2 sequence. If the Lead pump runs for 60 seconds at maximum speed, Lag 1 pump is started and the pumps continue to run at the 9-foot set-point. If both the Lead and Lag 1 pumps run at maximum speed for 60 seconds, Lag 2 pump is started. For emergency operation during a PLC or communications failure, a float switch is installed at elevation 636.75 that starts three pumps when activated. The critical system elevation representing a potential overflow is located at an upstream junction box on the interceptor line which has experienced overflows in the past. The rim elevation at this junction structure is approximately 641.8 feet. Maintaining adequate pumping across the river in order to keep the hydraulic grade line of the upstream conveyance system below 641.8 feet is crucial to the ongoing operational success of this station and preventing overflows.

The EBPS will be designed with a diversion chamber directly connected to the 72-inch interceptor sewer upstream of Citico Pump Station. Flow staging above 636.50 will overflow a weir into the EBPS and engage the backup pumps. The EBPS weir elevation will be adjustable.

2.4 Electrical Reliability Improvements

Considering the critical nature of the Citico Pump Station, the existing power distribution system has limitations. The limitations include a single permanent source of power, limited redundancy, and limited on-site backup power generation capability. A loss of utility power will result in no available power connection to all of the CSOTF and a limited source for operation of the main pump station via the trailer-mounted generator.

2.4.1 On-Site Backup Power Generation

To minimize the risk of power loss to the pump station and CSOTF, an on-site permanent backup power generator is required. The City's trailer-mounted generator is not viable as a permanent back-up power source, as the generator size is not large enough to support the firm capacity of the Citico Pump Station. No automatic transfer control scheme is in place, so the portable generator cannot be utilized for back-up power until operations staff can arrive at the station following a utility power outage. Staff must manually isolate the utility source and close the generator switchgear circuit breaker to connect the generator source to the switchboard bus using the key-interlock scheme. Although the generator is connected to the main switchboard bus to support pumps in the pump station, the generator source is electrically-isolated from

the CSOTF and therefore cannot be used as a back-up power source for CSO treatment or treated effluent pumping. Furthermore, wiring connections from the generator to the switchgear are made with portable cables routed exposed along the ground. The cabling is subject to degradation due to weather and is at risk of being damaged and vandalized. To improve overall electrical system reliability, a new outdoor diesel engine generator will be installed.

2.4.2 Provisions for Second Utility Service

A single overhead 12kV circuit from EPB enters the site and is connected to the primary of a single pad-mounted substation transformer. The station is normally connected to EPB circuit RIV 209. If a fault occurs on circuit RIV 209, the EPB distribution system is equipped with auto-reclosing control that attempts to reclose the substation circuit breaker for RIV 209 within approximately 5 seconds following the fault. If the reclosing is unsuccessful, the EPB system is capable of automatically switching the overhead line to other 12kV circuits after approximately 10 seconds. An extension of the overhead system from one of the other EPB feeders to the site has been discussed as a future addition that would allow for additional redundancy for the primary power source to the pump station. The second overhead service would allow the pump station load to be transferred from the primary utility service to the alternate utility source utilizing a transfer control scheme at the pump station. The intent of the alternate utility source is for it to be used only in the event of an outage to the primary utility circuit, and not normally connected and sharing station load at all times. This project will allocate real estate and place conduit for a second pad-mounted transformer to be installed in the future, however the second transformer will not be installed as part of this project.

2.4.3 Eliminate Single Points of Failure

The existing pump station electrical one-line has multiple single points of failure that could result in loss of power to much or all of the overall Citico station facilities. Perhaps the most significant single point of failure is the main switchboard within the pump station. A failure of the main circuit breaker or a fault on the main bus of the switchboard would render the station out of service, as neither the utility source nor the portable generator could be used to supply the Citico pumps. One of the goals of the electrical reliability improvements is to eliminate as many of these potential failure points as possible. To minimize the risk of an outage or fault impacting all Citico pumps, this design will electrically isolate one of the pumps from the other three in a split bus arrangement, such that stand-by power or an alternate source could be connected to the electrically isolated pump.

2.5 Mechanical Improvements

2.5.1 Odor Control System Replacement

A new odor control system will be installed to replace the existing system and to provide capacity for the new EBPS. The carbon media capacity in the existing pump station is undersized and requires frequent maintenance. At the direction of City staff, the new odor control system will be designed based on a linear scale-up of air handling equipment and carbon capacity for the unit to increase by 50 percent. This scale-up is intended to reduce the frequency of carbon replacement. Staff reports that other pump stations in the City are on a schedule for annual carbon replacement. The room presently housing the odor control system will be reallocated for electrical equipment and a new odor control system will be installed outside the pump station. A driveway adjacent to the new odor control system pad will allow direct access for carbon removal and replacement.

2.5.2 Air Conditioning System

Moisture and other air constituents have degraded the air conditioning unit and ductwork which serve the existing pump station electrical room and the equipment must be replaced. The existing odor control equipment room will be converted to an electrical equipment room, and a new air conditioning unit is required to protect the new equipment. Two doorways and a portion of the plenum in the existing mechanical room will be isolated and closed to bring the space into compliance with NFPA code for hazardous areas.

2.6 Existing Force Main Conditions Assessment

The existing 30- and 48-inch wastewater force mains crossing the Tennessee River from Citico Pump Station have been in service since approximately 1954 and 1989, respectively. The newer 48-inch line is Class 51 DIP, while the river crossing portion of the 30-inch is concrete pressure pipe of an unknown specification. A conditions assessment will be undertaken during the construction phase of this project to determine the serviceability of each force main and to make recommendations on potential refurbishment or replacement. Due to the dissimilar material of the new force mains and challenges associated with emptying the pipes, sonar technology will be utilized for the assessment. The assessment technology requires physical access to the pipe, but site constraints do not allow for the consideration of full pigging stations. Manholes over tees with blind flanges on the force mains will be installed within the pump station security fence to allow direct access to the pipes for assessment. During this construction, an isolation valve will be installed on the 48-inch river crossing force main, as there is currently no capability to close off flow from Citico to this force main. The new valve on the 48-inch DIP line will be within the pump station driveway pavement.

3.0 DESIGN RECOMMENDATIONS

3.1 Emergency Backup Pump Station

3.1.1 Pump Selection

The two existing discharge force mains from Citico create six potential pumping scenarios for the proposed EBPS by combining one or both pumps in operation with one or both force mains. A flow-splitting tee with manually-actuated plug valves on each branch will be installed on the EBPS discharge piping and allow the station to utilize either the 30- or 48-inch force main, or both. Table 3-1 establishes the six scenarios and corresponding TDH for each run, which was calculated by modeling the proposed system using AFT Fathom 9 software with an assumed C-factor of 100 for the existing DIP and concrete pressure pipes crossing the river. An assumed C-factor is used because a current condition assessment of the force mains is not available. The river crossing force mains, each approximately 2,000 feet in length, discharge to a manhole on the north side of the river at a centerline elevation of 648.5 feet (per as-built design data). The design static head for the EBPS pumps is 13.5 feet, based on the discharge pipeline elevation of 648.5 feet and an assumed normal operating wet well level of 635.0 in the EBPS. The discharge on the north side of the river is lower than the EBPS discharge piping header, so the header piping will drain down to the wet well elevation at each pump stop. The pump risers will be equipped with combination air vacuum valves to protect the pump station piping. The EBPS is designed to operate when the Citico Pump Station is not in service. For this reason, the EBPS hydraulics do not include losses associated with the Citico station pumping.

Table 3-1: Emergency Backup Pumping Scenarios

Scenario	Pump 1 (22.5 MGD)	Pump 2 (22.5 MGD)	Ex. 48-inch WWFM	Ex. 30-inch WWFM	TDH (ft)
1	ON	OFF	OPEN	CLOSED	17
2	ON	OFF	CLOSED	OPEN	32
3	ON	OFF	OPEN	OPEN	16
4	ON	ON	OPEN	CLOSED	21
5	ON	ON	CLOSED	OPEN	74
6	ON	ON	OPEN	OPEN	19

The maximum design capacity of the EBPS established the selection of pumps and operating scenarios. Both pumps are equipped with VFDs to allow them to match pumping output to the incoming flow. Table 3-1 shows the range of pumping head for each discharge force main scenario, including the head

conditions operating through the valve to the 30-inch force main only. Pumps were selected specifically for scenarios 4 (primary) and 1 (secondary), with a design goal of 22.5 MGD per pump at approximately 21 feet of head. In this configuration the 48-inch force main is open and the 30-inch force main is closed. The remaining scenarios are also feasible with the exception of full flow through the 30-inch force main alone. In the event of a failure of the 48-inch force main (the primary pumping scenario), one pump will be able to operate through the 30-inch force main only.

3.1.2 Pump Station Configuration

3.1.2.1 Site Layout

The EBPS will be constructed adjacent to the Citico Pump Station, on the north side of the existing structure. The Tennessee River 100-year flood stage elevation of 657.00 feet constrains the site unless permitting is undertaken for the construction of permanent embankment within the flood plain. This design is focused on constructing improvements outside the flood plain limits. The proposed EBPS will be constructed below grade with hatch covers at the elevation of the existing driveway. Actuators for the slide gates within the station will be above grade, and a hoist crane above the station will provide for the removal of pump and grinder equipment from the wet well. Preliminary drawings included in Attachment 1 detail the existing site and proposed site improvements.

Due to the adjacent flood plain, site improvement constraints require that the proposed EBPS be constructed as near as possible to the existing Citico pump station structure. Buoyancy of the existing station was analyzed in order to account for the removal of existing soil where the new station will be constructed. Structural calculations confirmed that temporary removal of the soil north of the structure would not endanger the existing station. Structural analysis was also performed to consider the flexural and shear strength of the existing station walls for the additional soil forces caused by the new EBPS structure nearby, as well as for the hydraulic load on the north wall caused by the pump station being full but no surrounding soil being present to counteract that hydraulic force. In order to protect the existing walls, the EBPS footing elevation must be at or near to the elevation of the existing station slab. Though the depth is significant, approximately 40 feet, the placement of the EBPS structure bottom at the same elevation as the existing station is also beneficial to the selection of new pumps and the controls scenario. All portions of the new EBPS will be considered confined spaces and signage at the site will indicate that only permitted entry will be allowed. All equipment will be installed such that maintenance and monitoring during normal operation can be achieved without confined space entry. Preliminary drawings included in Attachment 1 include section drawings of the EBPS structure.

3.1.2.2 Flow Configuration

The EBPS will be constructed to take flow from the 72-inch gravity interceptor sewer immediately upstream of the existing Citico Pump Station. The new EBPS diversion chamber and the wet well for the EBPS will be constructed as a single structure, built atop the 72-inch RCP interceptor. Wastewater will divert to the backup pumps by flowing over a weir into the EBPS diversion chamber, which will occur during an emergency event if the Citico Pump Station goes out of operation. A new electric motor-operated slide gate on the 72-inch RCP will be installed within the EBPS diversion chamber such that flow can be completely isolated from Citico, which will also cause flow to enter the EBPS wet well. The EBPS pumps will engage automatically by level control.

Maceration will be provided to protect the new EBPS pumps and the downstream MBWWTP. At the direction of City staff, a passive screen will not be considered due to the depth of the station and the confined space entry which would be required to maintain it. Three mechanical grinders or similar equipment will be installed to meet the maximum capacity plus one unit, such that a single grinder can be out of service while the station continues to operate at capacity. The grinders, or similar maceration equipment, will be oriented to accept flow downstream of the EBPS weir, and will operate automatically based on water level. The grinders will be installed with guide rails and hoists for maintenance accessibility without confined space entry. Motor-operated slide gates upstream of each grinder unit will allow a single channel to be closed from flow while a unit is out of service.

The EBPS operates automatically based on wet well level and a pump speed signal from the Citico main PLC. Macerated flow will enter the EBPS wet well downstream of the grinders. The EBPS wet well will be rectangular in shape and designed to meet Hydraulic Institute requirements for minimum dimensions, baffles, and flow channelizing arrangement. Two duty pumps rated for 22.5 MGD each, with no standby pump, will convey wastewater directly into the river crossing force mains. The EBPS will be equipped with two 24-inch pump discharge risers connected to a 36-inch pipe manifold which will split at a tee north of the EBPS to connect east and west to both the existing 30- and 48-inch force mains. Each pump discharge line will be installed with a combination air vacuum valve due to the header elevation being higher than the discharge on the north side of the river. Each pump discharge line will also have a swing check valve and plug valve in the adjacent valve vault. Plug valves will be installed at each run of the splitter tee between the 30- and 48-inch river crossing force mains such that flow can be diverted to each or both lines. The pump discharge line valves in the vault will be equipped with hand wheels and the below grade valves in the yard with valve boxes and manual square nut operators. Refer to the preliminary drawings included in Attachment 1 which include section drawings of the EBPS structure.

The existing Citico Pump Station is metered within the station. Effluent flow through the EBPS will be measured by a weir equation from level transmitters at the diversion chamber weir.

Odor control for the EBPS will be incorporated into the capacity of the new odor control system which also handles the Citico Pump Station wet well. Section 3.3 discusses the odor control improvements.

3.2 Electrical Reliability Improvements

BMcD considered several approaches to reconfiguring the electrical systems at the Citico Station in an effort to address all of the objectives described above. Specific features and benefits of the proposed electrical configuration are discussed below. The configuration recommended to achieve the stated objectives is depicted in the preliminary electrical one-line diagram, Sheet E602 of Attachment 1.

3.2.1 Service Entrance Switchgear

A new service entrance switchgear will be provided as the centerpiece of electrical improvements. The switchgear will be configured with three main circuit breakers. Two incoming circuit breakers will be provided for 480Y/277V secondary service from primary and alternate utility sources, and one incoming circuit breaker will be provided for connection of an on-site generated source. The switchgear will also be configured with a bus-tie circuit breaker to allow for electrical isolation of various loads for maintenance purposes and for generator exercising under load. All circuit breakers including mains, tie and feeders will be electrically-operated, draw out type. The switchgear will be provided with an automatic transfer control system. The automatic transfer control scheme will be initially set up to transfer between the existing utility service and the proposed permanent generator service with the capability to modify the control scheme to incorporate the second utility feed into the transfer scheme in the future. The switchgear will provide power monitoring of all three service connections. The switchgear will be located in the modified equipment room of the existing Citico Pump Station following the planned demolition of the existing odor control equipment which is to be replaced.

3.2.2 Distribution Switchboard

A new 480Y/277V distribution switchboard will be provided and supplied via a cable bus system from a feeder breaker in the new service entrance switchgear. The distribution switchboard will be located in the equipment room of the existing pump station. The switchboard will be furnished as main lug only and with molded case feeder breakers to supply various loads as identified on the attached one-line diagram. The separate switchboard for distribution is intended to improve arc flash hazard conditions downstream of the service entrance switchgear and for a more cost effective solution compared to the draw-out style metal-enclosed switchgear.

3.2.3 Permanently Installed Backup Diesel Generator

A permanent diesel engine generator will be provided for back-up power. Preliminary calculations yield a required size of 1750 kW, which will support several different load combinations at the Citico Station. Primarily, the generator will be sized to simultaneously support the rated capacity of the Citico Pump Station at 118.8 GPM (three pumps) and the CSOTF, excluding effluent pumping. In the event of a high river condition and the need for CSO effluent pumping, the generator will support all CSO treatment and effluent pumping loads along with limited pumping from either the existing Citico pumps or the EBPS pumps. Lastly, the generator will also be able to provide power for the full capacity of the EBPS, however it will not be able to power the Citico Pump Station at rated capacity and the EBPS simultaneously. The generator will serve as a second option power source initially, prior to the redundant utility service being installed. When the redundant utility service is installed, the generator will become the third priority power source.

The generator will be permanently mounted on a concrete slab, and will be positioned outside the 100-year flood plain of the Tennessee River. The generator will be specified with a sound-attenuating enclosure to achieve a maximum sound power level of 70 dBA at a distance of 50 feet from the enclosure. The diesel engine will have a belly-mounted fuel tank with capacity for 24 hours of operation. The security fence around Citico will be extended to encompass the new generator with the necessary access to accommodate a refueling truck. All non-drivable disturbed areas within the expanded fence line will be finished with crushed stone or other pervious material.

3.2.4 Redundant Utility Service

Provisions for a second redundant utility feed will be installed. The provisions for this service will include a fully installed and functional main breaker within the switchgear and duct bank system for the future transformer secondary conductors to the service entrance switchgear. Site planning will also include an allocated location on the site for the future pad-mounted transformer, however no pad will be provided and the redundant utility service conductors will not be installed as part of this project. The future transformer pad will be located outside of the 100-year flood plain. When installed, the second utility source is intended to be energized to the site, but not normally supporting any Citico station loads. The source will be designated as a “stand-by” or alternate service.

3.2.5 Redistribution of Existing Facility Loads

Citico Pump Station pumps, the EBPS, CSOTF, and CSO effluent pumps will be distributed between the two distribution switchboards that are supplied from the new service entrance switchgear as indicated on the proposed electrical one-line diagram (see attached drawing, Sheet E602). This reconfiguration will

allow the flexibility of isolating the two busses on either side of the tie breaker should a fault occur on one side, or for maintenance activities. The bus-tie will normally be in the closed position allowing all loads at the Citico Pump Station to be supplied from the normal utility source. The bus-tie and split bus configuration will also allow for regular testing and exercising of the stand-by generator with and without load connections, and without interruption of service to normal pumping operation.

As an added redundancy feature, an auto-transfer switch will be provided so that the existing 480V MCC at the Citico pump station can be supplied from either bus of the new switchgear. The MCC supplies loads that are critical to operation of the pump station. The timing of the transfer from one source to the other will be coordinated with other electrical system transitions that will occur at the service entrance switchgear. The transfer switch will be located in the equipment room of the existing pump station.

3.2.6 EBPS Electrical Service

A new electrical system will be provided for the EBPS. The backup pumps will be supplied with VFD's and individual feeders from the new distribution switchboard. VFD's will be located in the equipment room of the existing pump station. Additional electrical loads associated with the EBPS such as the grinders will be supplied at 480V from existing pump station distribution panels or from a new 480V panelboard.

3.2.7 Controls and Instrumentation

A new PLC-based control system will be provided for control of the EBPS and for monitoring the status and alarm conditions of other equipment and systems. The PLC system will be specified with a GE RX3i processor to be consistent with City of Chattanooga control system standards. Networking of the new PLC system with the existing Citico pump station PLC and with the new EBPS VFD's will be considered during final design for integration of control functions and as a cost effective solution to an individually hardwired control interface. Critical alarm conditions will be hardwired from the PLC network to the existing pump station RTU for alerting operations staff at the MBWWTP via the existing telemetry system.

New instrumentation will be provided at the EBPS for control of the EBPS pumps and grinders, and for other alarm conditions as follows:

Level transmitters will be installed in the EBPS diversion chamber up- and down-stream of the weir with analog signals transmitted to the PLC. The PLC will be capable of generating level alarm conditions which correspond to the elevation of the top of the weir, alerting the operators that the EBPS is being put into service. Flow will be measured in the EBPS via a weir equation from these level transmitters, which

will be transmitted to the PLC for local display of the effluent flow. The PLC will be wired to the grinder control panels. The PLC will start the grinders based on the level transmitter downstream of the weir.

A level transmitter will be installed in the EBPS wet well with an analog signal transmitted to the PLC. The PLC will provide the logic for EBPS pump starting, stopping, and speed control based on a level set point for the wet well. High and low level switches will be installed in the EBPS wet well for discrete alarms as a back-up to the analog level control performed by the PLC.

3.3 Mechanical Improvements

Ventilation and air conditioning improvements will be undertaken inside the existing pump station to replace aging and deteriorated equipment, protect the new electrical equipment being installed, and to replace the odor control system. Mechanical design will adhere to the following codes and standards:

- National Fire Protection Association (NFPA) Codes, Standards, and Recommendations.
- Occupational Safety and Health Administration (OSHA) Standards Manual.
- Sheet Metal and Air Conditioning Contractor's National Association (SMACNA).
- American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)

3.3.1 New Odor Control System

The existing odor control unit will be demolished and a new odor control unit will be installed to serve the new EBPS and the existing Citico pump station screening room and wet well. The odor control unit will be located outside of the existing pump station and the drums will be on an equipment pad to allow direct access to the driveway. In the absence of influent air composition data that would normally be used to develop mass loadings of constituents such as hydrogen sulfide, mercaptans, dimethyl disulfide, skatoles, and other odor-causing compounds, a proper sizing of odor-treatment equipment cannot be performed in a manner consistent with standard practice. The design of the system will be based on a linear scale-up of the existing system, and BMcD does not warranty or guarantee the performance of this equipment in regards to any reduction in odors or odor-causing compounds. To de-rate the EBPS from a Class I, Division 1 to a Class I, Division 2 area, NFPA-820 requires continuous ventilation at a minimum of 12 air changes per hour. New supply fan(s) and associated ductwork will provide supply air to the wet well and Screen Room. The new odor control system will act as the exhaust. The supply and exhaust will maintain a negative differential pressure relative to ambient pressure of -0.1 inches water column. FRP ductwork will be routed below grade from the EBPS to the new odor control unit. Explosion-proof unit heaters will be provided to temper air during winter months and protect against freezing.

3.3.2 Existing Mechanical Room

The Mechanical Room currently serves as a plenum space to provide air into the dry well and wet well, and it houses part of the split A/C unit that currently serves the Control Room. To comply with NFPA-820 F-2, the existing wall penetration for the fan supplying air to the Screen Room and wet well will be closed to separate the Mechanical Room from the adjacent Class I, Division 2 rated Screen Room. The existing split A/C unit and ductwork will be removed and replaced. The unit controls will include an "ON-OFF" supply fan selector and a "HEAT-COOL-OFF" selector located within wall-mounted thermostats and placed in the Control Room.

3.3.3 Existing Control Room

The existing pump station electrical equipment is housed in the Control Room next to the Mechanical Room. This room is currently served by the split A/C unit in the Mechanical Room described previously. The existing ductwork, which is rusted and deteriorated, will be demolished and replaced.

3.3.4 Existing Screen Room

The Screen Room, which is open below the wet well, is not physically separated from the rest of the upper floor of the existing pump station and would be treated as one space. To reduce the classification of the Screening Room and wet well from a Class I, Division 1 area to a Class I, Division 2 area, NFPA-820 requires continuous ventilation at a minimum of 12 air changes per hour. The existing supply fan F-2 and existing exhaust fan EF-2 will be demolished and the wall penetrations closed to provide physical separation between rooms. A new supply fan will be provided and installed on an exterior wall to provide supply air to the Screening Room and the existing Wet Well. Explosion-proof unit heaters will be provided to temper the space and prevent freezing. The new odor control unit (refer to Section 3.3.1) will serve as the exhaust for the Screen Room and wet well. The supply and exhaust will maintain a negative differential pressure relative to ambient of -0.1 inches water column as required by NFPA-820. The existing FRP ductwork inside the pump station will be capped and diverted to new ductwork which will exit the wet well space below grade and cross under the driveway to the new odor control system pad outside.

3.3.5 New Electrical Equipment Room

The Equipment Room currently housing the existing odor control system will be repurposed as an electrical equipment room. The existing odor control unit, odor control fan EF-1, FRP ductwork, louver L1, unit heater, and exhaust fan EF-3 will be demolished. NFPA-820 requires a physical separation between unclassified and classified areas. To provide a physical separation, a single doorway and a roll-up door between the equipment room and the Screen Room will be permanently closed and walled in. The

penetrations for louver L1 and exhaust fan EF-3, and the floor opening for the 30-inch FRP odor control exhaust ductwork will also be permanently closed to provide physical separation. Two new through-wall air conditioners with electric heating and associated supply and return ductwork will be provided to address heat loads and positively pressurize the space relative to ambient pressure by 0.1 inches of water column. The unit controls will include an "ON-OFF" supply fan selector and a "HEAT-COOL-OFF" selector located within wall-mounted thermostats.

3.3.6 EBPS Wet Well

To reduce the classification of the new wet well from a Class I, Division 1 area to a Class I, Division 2 area NFPA-820 requires continuous ventilation at a minimum of 12 air changes per hour. A new supply fan and associated ductwork will provide supply air to the wet well and a new odor control system will act as the exhaust. The supply and exhaust will maintain a negative differential pressure in the wet well relative to ambient pressure of -0.1 inches water column as required by NFPA-820. FRP ductwork will be routed below grade from the new wet well to the new odor control unit. Explosion-proof unit heater(s) will be provided to temper air during winter months and protect against freezing.

3.4 Existing Force Main Improvements

A new isolation valve must be installed on the 48-inch DIP force main both for construction sequencing and for long-term flexibility of operation at the pump station. While flow from Citico is isolated to only the 30-inch force main, construction will take place to install the new 48-inch isolation valve, the EBPS force main connection to the 48-inch line, and a permanent physical access point for pipeline access downstream of the isolation valve. This access point will be a blind flange set in a manway structure to allow insertion of condition assessment equipment. Similar construction will take place on the 30-inch force main to install the EBPS connection and access point, however an isolation valve already exists on the 30-inch within the Citico Pump Station such that flow can be shut off and diverted to the 48-inch line only.

4.0 CONSTRUCTION SEQUENCING

4.1 Introduction

Construction sequencing will be critical to the success of the pump reliability improvements project. Generally, all proposed improvements should be completely constructed prior to connections being made to the existing systems. All planning for construction should target minimizing the down-time of Citico Pump Station and the CSOTF. Construction of the EBPS should take place such that the 72-inch RCP influent line to Citico remains intact and unaffected until all equipment in the EBPS is installed and

online. Flow bypass during the construction will be limited to the duration of the EBPS connection to the 72-inch RCP, such that the EBPS will be operational as soon as the connection is made and the bypass can be discontinued.

4.2 Proposed Construction Activity Sequencing

Table 4-1 lists the proposed construction activities and the associated availability of pumps and flow per river crossing force main. Alternating flow through each force main will be necessary to sequence the construction of different connections to the existing system. The EBPS, odor control system, new backup generator, and all new switchgear and cabling should be constructed except for final connections to the existing system prior to any existing systems being taken offline. The CSOTF will remain in service through construction, and downtime will be limited to the switchover to the new electrical equipment following full construction of this project scope.

Table 4-1: Construction Sequencing for Force Main Flow

Seq.	Activity	48-inch WWFM	30-inch WWFM	PS Operating	Pumps Available	Power Source
1	Excavation for EBPS Build EBPS (72" intact) Generator Pad Construction Install Electric Duct Bank Install Odor Control Ducts Install Odor Control Unit Start up Odor Control Unit	Open	Open	Citico	P2,P3,P4	EPB
2	Install 48" FM plug valve* Install 48" FM Access Tie in EBPS to 48" FM Demo old Odor Control Unit Install new switchgear, distribution switchboard, and ATS	Closed	Open	Citico	P1	EPB
3	Install 30" FM Access Tie in EBPS to 30" FM Transition Citico P1 electrical source from ex. switchboard to new switchgear	Open	Closed	Citico	P2,P3,P4	EPB
4	Reconnect utility transformer source to new switchgear Reconnect CSOTF feeder and effluent pumps to new distribution switchboard	Open	Closed	Citico	P2,P3,P4	Trailer-Mounted Generator

Seq.	Activity	48-inch WWFM	30-inch WWFM	PS Operating	Pumps Available	Power Source
5	Bypass 72" Influent to FMs Install New Gate in EBPS Connect EBPS into 72" line Reconnect existing switchboard to new switchgear	Open	Open	Citico	P2,P3,P4 + Bypass	EPB
6	EBPS Online Install, connect, and test new permanent generator	Open	Closed	EBPS	P1,P2	EPB
7	All improvements online	Open	Open	Citico EBPS	P1-4 P1-2	EPB

**Requires piping and valve installation within Citico Pump Station to allow Pump No. 1 to operate on the 30-inch WWFM and be isolated from the rest of the station. This construction is currently being performed by the City.*

4.3 Staging

Site availability for staging is limited within the parcel owned by the City of Chattanooga. Approximately 10,000 square feet of grassed, open area immediately southeast of Citico may be available for staging, however this land is not City-owned and may require separate agreement with the land owner, Tennessee American Water. The area for construction staging is shown on drawing C101, Overall Site Plan, in the attached preliminary drawings.

4.4 Site Access

Citico Pump Station is accessible by vehicle from a driveway connection on Riverfront Parkway (State Road 58). This driveway and access to the adjacent facility operated by the Parks Department must remain open during construction. Access must also remain open for pump station operations staff and for the City's 21-foot-long truck which removes the screenings dumpster off-site to be emptied.

4.5 Community Impact

Citico Pump Station is located on the Tennessee Riverwalk, a concrete multi-use path adjacent to the river. Construction activities should be barricaded from access and visually screened from pedestrians utilizing the Riverwalk.

4.6 Permitting

Construction of these improvements will require permitting with authorities having jurisdiction, including the Tennessee Department of Environment and Conservation, the Tennessee Valley Authority, the US Army Corps of Engineers, and the City of Chattanooga.

4.6.1 USACOE & TVA

The EBPS improvements do not propose to impact any aquatic resources under the Waters of the United States regulations, however a permit application will still be required. A joint application will be made to the US Army Corps of Engineers (USACOE) and Tennessee Valley Authority (TVA) to demonstrate conformance with USACE Nationwide Permit, Section 3. Construction notification may not be required as long as the work adheres to the General Conditions under this permit.

4.6.2 TDEC

The Tennessee Department of Environment and Conservation will require plans review and potentially an application for Aquatic Resource Alteration Permit and State Water Quality Permit.

4.6.3 City of Chattanooga

The City Land Development office will require application for a Land Disturbing Permit (LDP) and a building permit to be obtained by the Contractor.

APPENDIX A - OPINION OF PROBABLE CONSTRUCTION COST

0.3 CAPITAL COST ESTIMATE
City of Chattanooga, TN
CITICO
Emergency Backup Pump Station
95307
Chattanooga, TN

Acct	Area / Discipline	Direct MHRS	Labor Cost	Material Cost	Engr Equip/ Subcontract Cost	Const. Equipment Cost	Total Cost
01	Engineered Equipment	1,360	$86,311		$1,171,564	$23,932	$1,281,807
02	Civil	9,995	$546,320	$270,600	$653,467	$191,594	$1,661,981
03	Deep Foundations						
04	Concrete	5,788	$315,061	$347,210	$68,563	$30,731	$761,565
05	Structural Steel	92	$5,676	$141,016		$1,235	$147,927
06	Architectural	954	$53,031	$71,172	$36,210	$19,770	$180,183
07	Piping	578	$35,566	$864,519		$5,991	$906,076
08	Electrical	3,856	$317,507	$1,764,911	$53,795	$15,987	$2,152,200
09	Instrument & Control						
10	Insulation						
11	Coatings						
12	Specialty						
13	Demolition						
14	Misc Directs						
	Total Direct Cost	**22,623**	**$1,359,472**	**$3,459,428**	**$1,983,599**	**$289,240**	**$7,091,739**

Rev.	Revision Date
0	12-16-16
1	01/25/17
2	02/13/17
3	02/16/17

Construction Mgmt & Indirects		
Engineering		
Start-Up		
Commercial		
Escalation		
Total Indirect Cost		
Total Direct and Indirect Costs		**$7,091,739**
Project Contingency	15%	$1,063,761
G&A		
EPC Fee		
Total Project Cost		**$8,155,500**
Owner Cost - General, Taxes & Fees		
Owner Cost - Owner Contingency		
Total Project Cost Incl. Owner Cost		**$8,155,500**

BURNS McDONNELL V 2.6

ATTACHMENT 1 - PRELIMINARY DRAWINGS

TENNESSEE RIVER

30' STREAM BUFFER
DO NOT DISTURB

EX CITICO CSO
EFFLUENT PUMPS

48" SSFM ACCESS MANHOLE

48" SSFM ISOLATION VALVE

30" SSFM ACCESS MANHOLE

CHAIN LINK FENCE & GUARDRAIL

CHAIN LINK FENCE

PARKS
DEPARTMENT
BUIDLING
(OFFSITE)

EMERGENCY BACKUP
PUMP STATION (EBPS)

SCREENINGS DUMPSTER ROLL-UP DOOR
(SEE NOTE 3)

EX CITICO PUMP STATION

ODOR CONTROL SKID

12' CONC DRIVE ACCESS
TO ODOR CONTROL

EX CITICO CSOTF

PERMANENT DIESEL
GENERATOR

12' GATE

FUTURE PAD-MOUNTED TRANSFORMER (NIC)

100-YR FLOOD ELEVATION = 657'

CONSTRUCTION
STAGING
(SEE NOTE 1)

ACCESS DRIVEWAY TO RIVERFRONT PARKWAY (SR 58)
(SEE NOTE 2)

NORTH

0 10' 20' 40'
SCALE IN FEET

NOTES:
1. CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATING STAGING AREA WITH OWNER. EXISTING OPEN SPACE SOUTHEAST OF CITICO PUMP STATION CROSSES A PARCEL LINE TO THE ADJACENT PROPERTY OWNER. CONTRACTOR SHALL ACQUIRE NECESSARY TEMPORARY EASEMENT FOR ACCESS AND STAGING PRIOR TO UTILIZING OFF-SITE OPEN AREA.
2. CONTRACTOR SHALL MAINTAIN ACCESS TO THE SITE THROUGHOUT CONSTRUCTION FOR PUMP STATION OPERATIONS STAFF AND PARKS DEPARTMENT STAFF.
3. CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATING WITH THE OWNER TO PROVIDE ACCESS TO THE DUMPSTER ROLL-UP DOOR AT THE NORTHWEST CORNER OF THE PUMP STATION FOR SCREENINGS REMOVAL.

PRELIMINARY - NOT FOR CONSTRUCTION

BURNS McDONNELL
3650 MANSELL ROAD, SUITE 300
ALPHARETTA, GA 30022
770-587-4776

CITICO PUMP RELIABILITY IMPROVEMENTS
CITY OF CHATTANOOGA, TN
CONSENT DECREE PROGRAM

REV	DATE	REVISION DESCRIPTION
A	2/6/17	60% REVIEW SUBMITTAL

THIS LINE ⌊_____⌋ IS ONE INCH
LONG WHEN PLOTTED FULL SCALE

THIS DRAWING MUST BE USED IN CONJUNCTION WITH THE APPLICABLE OR GOVERNING TECHNICAL SPECIFICATIONS AND OTHER CONTRACT DOCUMENTS.

PROJECT NO: 95307
DATE: 02/06/2017

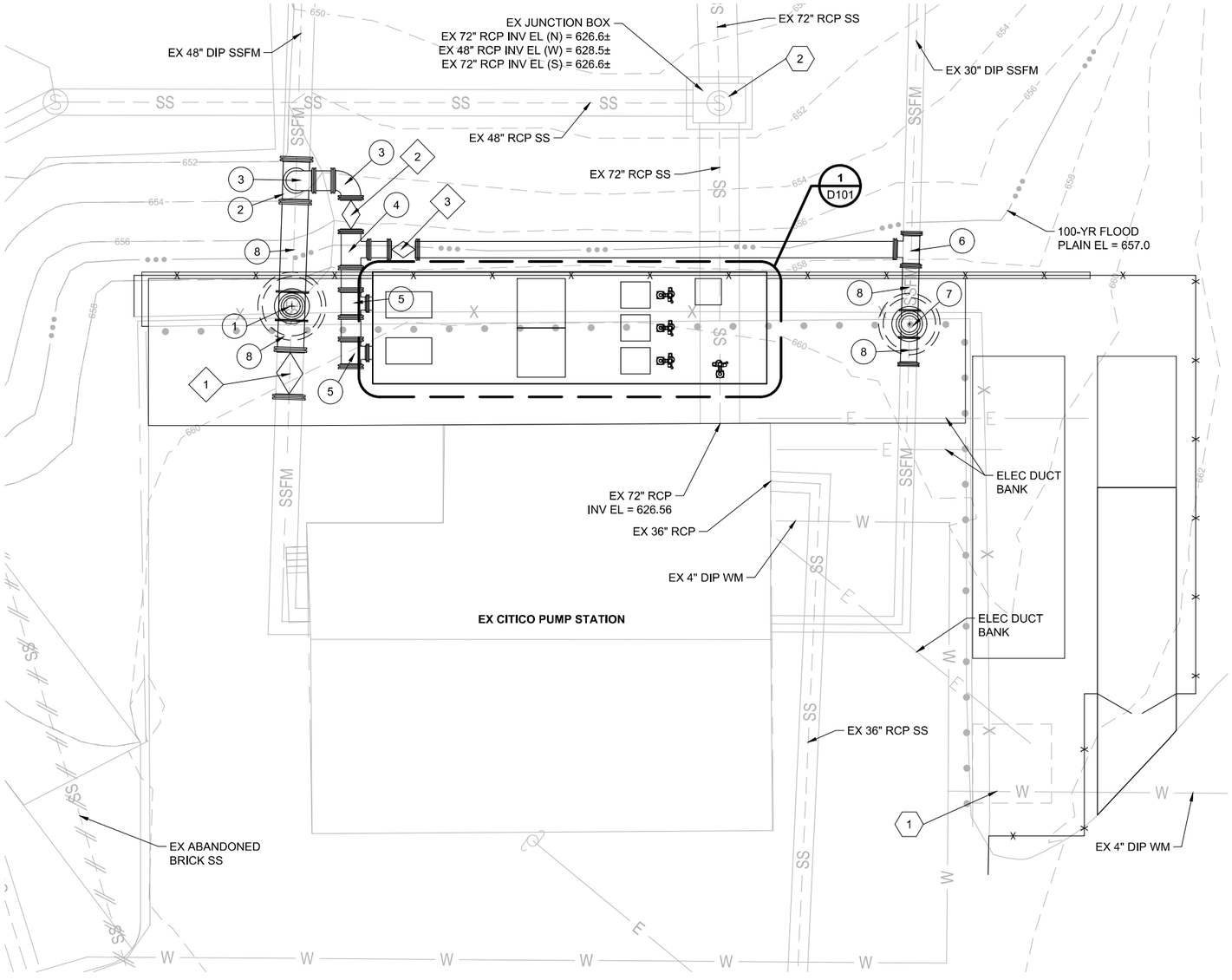
DISC. LEAD:	DESIGNER:	CHECKER:
PMB	SDA	PMB

SHEET TITLE
CIVIL

OVERALL SITE PLAN

SHEET C101 REV A

Z:\CLIENTS\WTR\CHATTANOOGTN\95307_CITICORELIABILDESIGN\CADD\CIVIL\PROD_DWGS\95307_C101.DWG 2/6/2017 11:43 AM SDADAMS2



NORTH

0 10' 20'
SCALE IN FEET

VALVE SCHEDULE

MARK	TYPE	TAG
1	48" PLUG VALVE	
2	36" PLUG VALVE	
3	30" PLUG VALVE	

PIPE FITTING SCHEDULE

MARK	TYPE	SIZE	COUNT
1	FLG TEE W/ BLIND FLG	48"-48"-30"	1
2	MJ TEE	48"-48"-36"	1
3	90° MJ BEND	36"-36"	2
4	MJ REDUCING TEE	36"-36"-30"	1
5	MJ REDUCING TEE	36"-36"-24"	2
6	MJ TEE	30"-30"-30"	1
7	FLG TEE W/ BLIND FLG	30"-30"-30"	1
8	MJ / FLG SPOOL PIECE	VARIES	4

KEYED NOTES:

1. LOCATION OF EXISTING 4" DIP WATER SERVICE SHOWN PER DESIGN DRAWINGS. CONTRACTOR SHALL POTHOLE AND VERIFY LINE AND DEPTH AND NOTIFY ENGINEER OF DISCREPANCIES. LOCATION OF FUTURE TRANSFORMER TO BE ADJUSTED TO CLEAR WATER SERVICE.
2. EXISTING JUNCTION BOX NO. 3 PER CONTRACT NO. CSO-5b-99 (1999) TO BE UTILIZED FOR BYPASS.

NOTES:
1. ALL YARD PIPING TO BE DUCTILE IRON WITH FULLY RESTRAINED MECHANICAL JOINTS UNLESS OTHERWISE NOTED.

PRELIMINARY - NOT FOR CONSTRUCTION

BURNS McDONNELL
3650 MANSELL ROAD, SUITE 300
ALPHARETTA, GA 30022
770-587-4776

CITICO PUMP RELIABILITY IMPROVEMENTS
CITY OF CHATTANOOGA, TN
CONSENT DECREE PROGRAM

REV	DATE	REVISION DESCRIPTION
A	2/6/17	60% REVIEW SUBMITTAL

THIS LINE ⌊——⌋ IS ONE INCH LONG WHEN PLOTTED FULL SCALE

THIS DRAWING MUST BE USED IN CONJUNCTION WITH THE APPLICABLE OR GOVERNING TECHNICAL SPECIFICATIONS AND OTHER CONTRACT DOCUMENTS.

PROJECT NO: 95307
DATE: 02/06/2017

DISC. LEAD:	DESIGNER:	CHECKER:
PMB	SDA	PMB

SHEET TITLE
CIVIL

UTILITY PLAN

SHEET C104 REV A

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ONE-LINE AND CONTROL DIAGRAMS

	POWER CIRCUIT AND EQUIPMENT INSTALLED BY THIS CONTRACT
	EXISTING CIRCUIT AND EQUIPMENT
	FUTURE POWER CIRCUIT AND EQUIPMENT
	EQUIPMENT ENCLOSURE
	CONTROL OR INTERLOCK CIRCUIT
(X)	"X" INDICATES NUMBER OF DEVICES WHEN MORE THAN ONE
	TERMINAL
	CONNECTION
	CIRCUIT BREAKER
	FUSE
	FUSED DISCONNECT SWITCH
	DISCONNECT SWITCH
	PLUG-IN OR DRAWOUT CONNECTION
	POWER TRANSFORMER (XFMR)
	CONTROL POWER TRANSFORMER
200:5 (2)	CURRENT TRANSFORMER, SINGLE RATIO (SHOWN WITH QUANTITY)
(2)	POTENTIAL TRANSFORMER (SHOWN WITH QUANTITY)
	DELTA WINDING CONNECTION
	GROUNDING Y WINDING CONNECTION
	DUAL THROW TRANSFER SWITCH
52-X	AC CIRCUIT BREAKER
K1	KEY INTERLOCK

	CAPACITOR
	THERMAL OVERLOADS
	SINGLE SPEED NON-REVERSING MANUAL MOTOR STARTER
	SINGLE SPEED NON-REVERSING MAGNETIC MOTOR STARTER
RVSS	REDUCED VOLTAGE SOLID-STATE STARTER
RVAT	REDUCED VOLTAGE AUTO-TRANSFORMER
VFD	VARIABLE FREQUENCY DRIVE
SPD	SURGE PROTECTION DEVICE
A	AMMETER
V	VOLTMETER
KWH	UTILITY METER
~	GENERATOR
HP	ELECTRIC MOTOR - APPROX. HORSEPOWER AS INDICATED
	EQUIPMENT AS NOTED ON DIAGRAM
	GROUND CONNECTION
	LIGHTNING ARRESTOR
X	ANSI DEVICE 86 = LOCKOUT RELAY 71 = OIL LEVEL SWITCH 49 = TRANSFORMER THERMAL SWITCH
TU	ELECTRONIC TRIP UNIT L = LONG TIME S = SHORT TIME I = INSTANTANEOUS G = GROUND

SCHEMATIC DIAGRAMS

	POWER CIRCUIT AND EQUIPMENT INSTALLED BY THIS CONTRACT
	EXISTING CIRCUIT AND EQUIPMENT
	FUTURE POWER CIRCUIT AND EQUIPMENT
	EQUIPMENT ENCLOSURE
	CONTROL OR INTERLOCK CIRCUIT
	REMOTE WIRING
	COMMUNICATION CABLE (COPPER)
FOC	COMMUNICATION CABLE (FIBER OPTIC CABLE)
	SOFTWARE OR COMMUNICATION LINK
	TERMINAL
+	POSITIVE TERMINAL
–	NEGATIVE TERMINAL
A B	(A) CONDUCTOR CONNECTION (B) NO CONNECTION
A B	(A) CONTACT - NORMALLY OPEN (B) CONTACT - NORMALLY CLOSED
	CIRCUIT BREAKER
	FUSE
	POWER TRANSFORMER (XFMR)
	GROUND CONNECTION
	LIGHTNING ARRESTOR
O.L. (3)	THERMAL OVERLOAD RELAY (SHOWN WITH QUANTITY)
	SOLENOID VALVE COIL
	SWITCH (AS DESIGNATED ON DIAGRAM)
	SELECTOR SWITCH (AS DESIGNATED ON DIAGRAM)

H A	HAND-OFF-AUTO SELECTOR SWITCH
	PHOTOCELL
A B	(A) PUSH-BUTTON - NORMALLY OPEN MOMENTARY (B) PUSH-BUTTON - NORMALLY CLOSED MOMENTARY
A B	(A) MAINTAINED PUSH-BUTTON - NORMALLY OPEN (B) MAINTAINED PUSH-BUTTON - NORMALLY CLOSED
A B	(A) PRESSURE OR VACUUM SWITCH-CLOSES WITH INCREASING PRESSURE OR DECREASING VACUUM (B) PRESSURE OR VACUUM SWITCH-OPENS WITH INCREASING PRESSURE OR DECREASING VACUUM
A B	(A) FLOAT OR OTHER LIQUID LEVEL SWITCH - CLOSES WITH RISING LEVEL (B) FLOAT OR OTHER LIQUID LEVEL SWITCH - OPENS WITH RISING LEVEL
A B	(A) LIMIT SWITCH - NORMALLY CLOSED (B) LIMIT SWITCH - NORMALLY CLOSED-HELD OPEN
A B	(A) LIMIT SWITCH - NORMALLY OPEN (B) LIMIT SWITCH - NORMALLY OPEN-HELD CLOSED
A B	(A) TEMPERATURE SWITCH - CLOSES WITH RISING TEMPERATURE (B) TEMPERATURE SWITCH - OPENS WITH RISING TEMPERATURE
R	INDICATING LIGHT - PILOT PUSH-TO-TEST TYPE WITH COLOR INDICATED: R-RED, A-AMBER, G-GREEN, W-WHITE, BL-BLUE, I-IVORY AND Y-YELLOW.

SCHEMATIC DIAGRAM DEVICE DESIGNATIONS

CONTACT CALLOUT

CR1 — DEVICE IDENTIFICATION
DEVICE DESIGNATION

NOTE: NO DIAGRAM NUMBER INDICATED SAME AS SCHEMATIC DIAGRAM NUMBER

CIRCUIT CALLOUT

CIRCLED NUMBER IS THE SAME NUMBER THAT APPEARS AFTER THE HYPHEN IN THE "CIRCUIT NUMBER"
B — WIRE COLOR DESIGNATION: B = BLACK; R = RED; ETC.

DEVICE CALLOUT

20-CR1 — DEVICE IDENTIFICATION
DEVICE DESIGNATION
DIAGRAM NUMBER (IF APPLICABLE)

	DESIGNATIONS DESCRIBING DEVICE OPERATION OR FUNCTION
A, AUTO	AUTOMATIC
ACK	ACKNOWLEDGE
CL	CLOSE
FWD	FORWARD
H	HAND
NC	NORMALLY CLOSED
NO	NORMALLY OPEN
O	OFF
OP	OPEN
REV	REVERSE
RMT	REMOTE

I/I	CURRENT TO CURRENT TRANSDUCER
IL	INDICATING LIGHT
IPB	ILLUMINATED PUSHBUTTON
ISP	ILLUMINATED SELECTOR PUSHBUTTON
ISS	ILLUMINATED SELECTOR SWITCH
LLS	LIQUID LEVEL SWITCH
LS	LIMIT SWITCH
M	MOTOR STARTER COIL OR CONTACT
MV/I	MILLIVOLT TO CURRENT TRANSDUCER
MX	MOTOR STARTER AUXILIARY RELAY
OL	OVERLOAD RELAY
PB	PUSHBUTTON
PS	PRESSURE SWITCH
SOL	SOLENOID (OTHER THAN VALVE)
SPB	SELECTOR PUSHBUTTON
SS	SELECTOR SWITCH
SV	SOLENOID VALVE
TDR	TIME DELAY RELAY
TMR	TIMER
TS	TORQUE SWITCH
VS	VACUUM SWITCH
XFMR	TRANSFORMER

ABBREVIATIONS

A	AMPERES	LC	LIGHTING CONTACTOR
AFF	ABOVE FINISHED FLOOR	LCP	LOCAL CONTROL PANEL
AFG	ABOVE FINISHED GRADE	LS	LIMIT SWITCH
AIC	AMPS INTERRUPTING CURRENT	LVT	LOW VOLTAGE TRANSFORMER
ATS	AUTOMATIC TRANSFER SWITCH	M	MOTOR
AWG	AMERICAN WIRE GUAGE	MCC	MOTOR CONTROL CENTER
BC	BARE COPPER WIRE	MCP	MAIN CONTROL PANEL
BCH	BATTERY CHARGER	MDM	MODEM (EXTERNAL PCS ALARM)
BF	BELOW FLOOR	N.C.	NORMALLY CLOSED
BG	BELOW GRADE	N.O.	NORMALLY OPEN
BKR	BREAKER	NER	NETWORK EQUIPMENT RACK
BSW	BYPASS SWITCH	NSW	NETWORK SWITCH
C	CONDUIT	OIT	OPERATOR INTERFACE TERMINAL
CAM	CAMERA	OWS	OPERATOR WORKSTATION
CB	CIRCUIT BREAKER	P	POLE
CP	CONTROL PANEL	PCS	PLANT CONTROL SYSTEM
CPP	COPPER PATCH PANEL	PDP	POWER DISTRIBUTION PANEL
CPT	CONTROL POWER TRANSFORMER	PHC	PHOTOCELL
CST	CONTROL STATION	PLC	PROGRAMMABLE LOGIC CONTROLLER
DRV	DRIVE / DRIVE MOTOR	PNL	PANELBOARD
DS	DISCONNECT SWITCH	PP	POWER PANEL
EL	ELEVATION	PRN	PRINTER
EO	ELECTRICALLY OPERATED	PSU	POWER SUPPLY UNIT
EPS	EMERGENCY PULL SWITCH	RCPT	RECEPTACLE
EX	EXPOSED	RGS	RIGID GALVANIZED STEEL
EXP	EXPLOSION-PROOF (CLASS 1, DIV 1, GROUP D)	SP	SPARE
EXT	EXTERIOR	SPD	SURGE PROTECTIVE DEVICE
FACP	FIRE ALARM CONTROL PANEL	SVR	SERVER
FOP	FIBER OPTIC PATCH PANEL	SW	SWITCH
FP	FIELD PANEL (PRE-PACKAGED)	TYP	TYPICAL
GEN	GENERATOR	UE	UNDERGROUND ELECTRICAL
GND	GROUND	UPS	UNINTERRUPTIBLE POWER SUPPLY
HH	HANDHOLE	VFD	VARIABLE FREQUENCY DRIVE
JB	JUNCTION BOX	WP	WEATHERPROOF
JS	POWER CONTACTOR	XFMR/XF	TRANSFORMER

PLANS

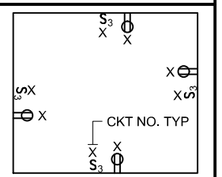
	NEW CONSTRUCTION
	EXISTING CONSTRUCTION
	CONDUIT EXPOSED
	CONDUIT CONCEALED IN WALL, CEILING OR HIDDEN FROM VIEW
	CONDUIT CONCEALED IN FLOOR OR UNDERGROUND
E	ELECTRICAL DUCT BANK
	FLEXIBLE CONDUIT
	HOME RUN TO PANELS, ARROWHEADS INDICATE NUMBER OF CIRCUITS
	CONDUIT TURNING UP
	CONDUIT TURNING DOWN
	CONDUIT TERMINATED AND CAPPED
	CONDUIT WITH BUSHING
	CONDUIT PASSING THRU ELEVATION
	CONDUIT CONTINUATION
	GROUND CABLE
	BOLTED GROUND CONNECTION
	WELDED GROUND CONNECTION
	GROUND ROD
	PANELBOARD
	DISCONNECT SWITCH
	FUSED DISCONECT SWITCH
	COMBINATION DISCONNECT/ MAGNETIC MOTOR STARTER
P	PULL BOX
M	MOTOR
J	JUNCTION BOX
T	THERMOSTAT
S	SINGLE POLE SWITCH
S_{3X}	THREE-WAY SWITCH "X" CORRESPONDS TO THE ASSOCIATED BANK OF LIGHTS (IF USED)
S_{WP}	WEATHERPROOF SWITCH
	TELEPHONE OUTLET
	DATA OUTLET
	TELEPHONE/DATA OUTLET

	FLUSH MOUNTED DUPLEX RECEPTACLE OUTLET
	SURFACE MOUNTED DUPLEX RECEPTACLE OUTLET
	FLUSH MOUNTED DUPLEX RECEPTACLE OUTLET. GROUND FAULT CIRCUIT INTERRUPTER TYPE. "WP" DENOTES WEATHERPROOF.
	SURFACE MOUNTED DUPLEX RECEPTACLE OUTLET. GROUND FAULT CIRCUIT INTERRUPTER TYPE. "WP" DENOTES WEATHERPROOF.
	SURFACE MOUNTED QUADRIPLEX RECEPTACLE OUTLET. "WP" DENOTES WEATHERPROOF. "GFCI" DENOTES GROUND FAULT CIRCUIT INTERRUPTER.
	SURFACE OR PENDANT FIXTURE (TYP FOR ALL LUMINIARE TYPES)
	SURFACE OR PENDANT EMERGENCY FIXTURE (WITH SELF-CONTAINED INTEGRAL BATTERY) PROVIDE A MIN. OF 90 MINUTES OF OPERATION
	SINGLE FACE EXIT LIGHT, ARROW DENOTES DIRECTION OF EGRESS, NO ARROW DENOTES NO EGRESS DIRECTION
	EMERGENCY BATTERY POWERED LIGHTING UNIT.
	POLE-MOUNTED AREA LIGHT
	INTEGRAL PHOTOELECTRIC CELL AND RELAY (PHOTOCONTROL)

CIRCUIT AND DEVICE IDENTIFICATION

CXXXX (ALTERNATE)
CXXXX (PREFERRED)
HOMERUN IDENTIFICATION

TYPE LX
CKT NO.
MTNG ELV
LUMINAIRE IDENTIFICATION



DEVICE ORIENTATION

CONDUIT, CABLE AND EQUIPMENT NUMBERING

CONDUIT NUMBER: CXXXX

CONDUIT TYPE:
FLEX - FLEXIBLE
RGS - RIGID GALVANIZED STEEL
RAL - RIGID ALUMINUM
CRGS - PVC COATED RGS
40PVC - PVC SCHEDULE 40
80PVC - PVC SCHEDULE 80
EMT - ELECTRICAL METALLIC TUBING

CONDUIT ROUTING:
AG - ABOVE GRADE
BG - BELOW GRADE

CABLE NUMBER: M-AAA-BBBXXXYZ-NNN
- SEQUENTIAL NUMBER (OPTIONAL)
- ASSOCIATED EQUIPMENT
- BUILDING/STRUCTURE DESIGNATOR (OPTIONAL)
- P: POWER
- C: CONTROL
- I: INSTRUMENTATION
- F: FIBER
- T: COMMUNICATIONS (COPPER)
- R: COAX

CABLE TYPE: REFER TO CABLE SPECIFICATION SECTION.

EQUIPMENT NUMBER: AAA-BBB-XXYZ
- UNIT NUMBER AND MODIFIER (OPTIONAL)
- LOOP NUMBER
- EQUIPMENT/INSTRUMENT INDENTIFIER
- BUILDING OR STRUCTURE ABBREVIATION (OPTIONAL)

GENERAL NOTES:

1. NOT ALL DEVICES AND DEVICE DESIGNATIONS SHOWN ONTHIS LEGEND ARE USED ON THIS PROJECT.
2. COORDINATE ALL CONDUIT TURN UP LOCATIONS AND PENETRATIONS WITH EQUIPMENT PROVIDED.
3. CONDUIT ROUTING DESIGNATED AS "AG/BG" DENOTES ABOVE-GRADE ROUTING TRANSITIONING TO BELOW-GRADE ROUTING AND VICE-VERSA.
4. REFER TO P&ID LEGEND DRAWING D001 AND D002 FOR ADDITIONAL INSTRUMENT AND EQUIPMENT ABBREVIATIONS.
5. ALL INSTALLATIONS SHALL COMPLY WITH THE NATIONAL ELECTRICAL CODE AND ALL APPLICABLE LOCAL CODES AND STANDARDS.

PRELIMINARY - NOT FOR CONSTRUCTION

BURNS McDONNELL
3650 MANSELL ROAD, SUITE 300
ALPHARETTA, GA 30022
770-587-4776

CITY OF CHATTANOOGA, TN
CITICO PUMP RELIABILITY IMPROVEMENTS
CONSENT DECREE PROGRAM

REV	DATE	REVISION DESCRIPTION
A	2/6/17	60% REVIEW SUBMITTAL

THIS LINE ——— IS ONE INCH LONG WHEN PLOTTED FULL SCALE

THIS DRAWING MUST BE USED IN CONJUNCTION WITH THE APPLICABLE OR GOVERNING TECHNICAL SPECIFICATIONS AND OTHER CONTRACT DOCUMENTS.

PROJECT NO: 95307
DATE: 02/06/2017

DISC. LEAD:	DESIGNER:	CHECKER:
CMK	CAB	CSH

SHEET TITLE
ELECTRICAL
LEGEND

SHEET E001 REV A

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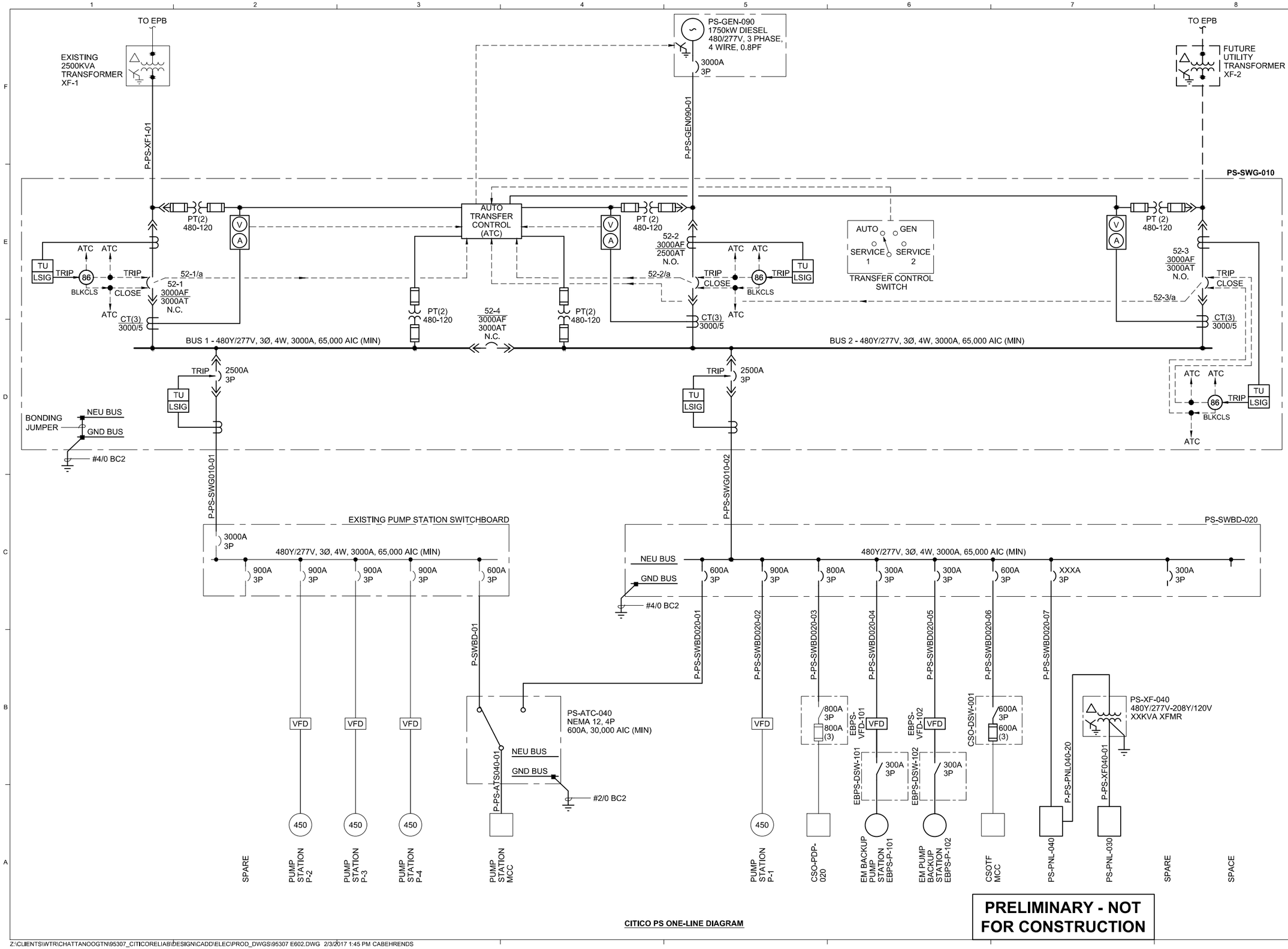

CITICO PS ONE-LINE DIAGRAM

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CMK	CAB	CSH

SHEET TITLE
ELECTRICAL
ONE-LINE DIAGRAM

SHEET E602 REV A

VALVES AND PIPING

- GATE VALVE
- GLOBE VALVE
- BUTTERFLY VALVE
- CHECK VALVE
- PLUG VALVE
- 3-WAY PLUG VALVE (2-PORT)
- 3-WAY PLUG VALVE (3-PORT)
- 3-WAY VALVE
- ANGLE VALVE
- PRESSURE RELIEF OR SAFETY VALVE
- HOSE GATE DRAIN VALVE
- PINCH VALVE
- NEEDLE VALVE
- DIAPHRAGM VALVE
- BALL VALVE
- BALL CHECK VALVE
- SELF-CONTAINED PRESSURE REDUCING (REGULATING VALVE)
- CONTROL VALVE BACK PRESSURE VALVE
- SURGE RELIEF VALVE
- KNIFE GATE VALVE
- CORPORATION STOP
- FILTER ELEMENT
- BLIND FLANGE
- CLEANOUT
- YARD HYDRANT
- AIR COCK
- HOSE BIBB
- AIR RELEASE VALVE
- VACUUM VALVE
- AIR AND VACUUM VALVE
- CONTROL VALVE STEM
- BACKFLOW PREVENTER
- VACUUM BREAKER
- MOISTURE SEPARATOR
- IN-LINE FLOW METER
- FLEXIBLE CONNECTION
- FLEXIBLE HOSE
- EXHAUST TO ATMOSPHERE (INSIDE)
- EXHAUST TO ATMOSPHERE (OUTSIDE)
- EXPANSION ELEMENT (JOINT)
- BASKET TYPE STRAINER
- Y-TYPE STRAINER
- DUPLEX STRAINER
- SLEEVE COUPLING (SC) HARNESSED SLEEVE COUPLING (HSC) INSULATED SLEEVE COUPLING (ISC)
- FLANGED COUPLING ADAPTER (FCA)
- DRAINER ASSEMBLY
- RESTRICTING ORIFICE
- STRAIGHTENING VANE
- RUPTURE DISK
- PIPE GUIDE
- PIPE WITH HEATING CABLE
- DRIP POCKET ASSEMBLY
- UNION
- PIPE ANCHOR
- REDUCER (CONCENTRIC)
- REDUCER (ECCENTRIC)
- DISCHARGE ELBOW ASSEMBLY
- REMOVABLE PLUG
- REMOVABLE CAP
- WELDED CAP
- WALL HYDRANT
- QUICK DISCONNECT COUPLING

VALVE OPERATOR SYMBOLS

- CYLINDER
- FLOAT
- MOTOR
- SOLENOID

EQUIPMENT

- SUBMERSIBLE PUMP
- GRINDER

PIPING ABBREVIATIONS

MISCELLANEOUS

BXS	BELL AND SPIGOT
BFPF	BELT FILTER PRESS FEED
BFPP	BELT FILTER PRESS POLYMER
CARV	COMBINATION AIR RELEASE VALVE
CL	CENTERLINE
DIA	DIAMETER
DIGO	DIGESTER OVERFLOW
DJ	DISMANTLING JOINT
DN	DOWN
EL	ELEVATION
FT	FEET
FCA	FLANGED COUPLING ADAPTER
GR	GRINDER
INV	INVERT
MGD	MILLION GALLONS PER DAY
MJ	MECHANICAL JOINT
NPW	NON-POTABLE WATER
PE	PLAIN END
PS	PIPE SUPPORT
PD	POSITIVE DISPLACEMENT
RAS	RETURN ACTIVATED SLUDGE
SSBO	SLUDGE STORAGE BASIN OVERFLOW
SW	SOCKET WELD
TP1	TREATMENT PLANT 1
TP2	TREATMENT PLANT 2
TYP	TYPICAL
UV	ULTRAVIOLET
WAS	WASTE ACTIVATED SLUDGE
WP	WALL PIPE

PIPING

CS	CARBON STEEL
CIP	CAST IRON PIPE
CPVC	CHLORINATED POLYVINYL CHLORIDE
DIP	DUCTILE IRON PIPE
FLG	FLANGE
GALV	GALVANIZED
HDPE	HIGH DENSITY POLYETHYLENE
LR	LONG RADIUS
PVC	POLYVINYL CHLORIDE
RCP	REINFORCED CONCRETE PIPE
RMJ	RESTRAINED MECHANICAL JOINT
SST	STAINLESS STEEL

VALVES

BFV	BUTTERFLY VALVE
BV	BALL VALVE
CTV	CONTROL VALVE
CV	CHECK VALVE
GV	GATE VALVE
HV	HAND VALVE
MV	MIXING VALVE
NC	NORMALLY CLOSED
PRV	PRESSURE RELIEF VALVE
PV	PLUG VALVE

EQUIPMENT

AD1	AEROBIC DIGESTER NO. 1
AD2	AEROBIC DIGESTER NO. 2
BFP	BELT FILTER PRESS
BPP	BELT FILTER PRESS PUMP
B	BLOWER
DEC	DECANTER
DIG	DIGESTER
GBT	GRAVITY BELT THICKENER
MXR	MIXER
P	PUMP
SG	SLIDE GATE
SFP	SLUDGE FEED PUMP
SSB	SLUDGE STORAGE BASIN
UV	ULTRAVIOLET
WT	WASTE TANK

INSULATION TYPE CODES

AC	ACOUSTIC CONTROL INSULATION
CC	COLD SERVICE INSULATION
CJ	CHILLED FLUID JACKETED
CP	CONDENSATION CONTROL
CT	CHILLED FLUID TRACED
ET	ELECTRIC TRACED
FP	FIRE PROTECTION INSULATION
HC	HEAT CONSERVATION INSULATION
HJ	HOT FLUID JACKETING
HT	HOT FLUID TRACED
PF	PREVENTION FROM FREEZING INSULATION
PP	PERSONNEL PROTECTION INSULATION
PS	PROCESS STABILITY INSULATION
SJ	STEAM JACKETED
ST	STEAM TRACED

DRIVERS

- MOTOR
- TURBINE DRIVER
- DIESEL ENGINE

NOTE:

1. THIS LEGEND IS TAKEN FROM A STANDARD MECHANICAL LEGEND AND NOT ALL ITEMS OR EQUIPMENT AS DESIGNATED HEREON ARE USED ON THIS PROJECT.

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CITICO PUMP RELIABILITY IMPROVEMENTS
CITY OF CHATTANOOGA, TN
CONSENT DECREE PROGRAM

REV	DATE	REVISION DESCRIPTION
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PROJECT NO: 95307
DATE: 02/06/2017

DISC. LEAD:	DESIGNER:	CHECKER:
PMB	SDA	PMB

SHEET TITLE
PROCESS

PROCESS LEGEND
SHEET 1

SHEET D001 REV A

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INSTRUMENT SOCIETY OF AMERICA

LETTER	FIRST LETTER(S)		SUCCEEDING LETTER		
	PROCESS OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS (*)		ALARM		
B	BURNER, COMBUSTION		USERS CHOICE (*)	CLOSE,STOP,DECREASE	USERS CHOICE (*)
C	CONDUCTIVITY			CONTROL	CLOSED
D	DENSITY (SG)	DIFFERENTIAL		OPEN,START,INCREASE	
E	VOLTAGE		SENSOR (PRIMARY ELEMENT)	EMERGENCY	
F	FLOW RATE	RATIO/BIAS			
G	GAUGE		GLASS, VIEWING	GATE	
H	HAND (MANUAL)				HIGH
I	CURRENT (AMPS)		INDICATE		
J	POWER	SCAN			
K	TIME, SCHEDULE	RATE		CONTROL STATION	
L	LEVEL		LIGHT		LOW
M	MOISTURE, MOTOR	MOMENTARY			MIDDLE, INTRMDT
N	TORQUE		USERS CHOICE (*)	ISOLATOR	ON, OPERATE
O	USERS CHOICE (*)		ORIFICE		OPENED
P	PRESSURE, VAC		POINT (TEST CONN)		
Q	QUANTITY	INTEGRATE, TOTALIZE			
R	RADIATION		RECORD, PRINT		
S	SPEED, FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE (*)		MULTIFUNCTIONAL (*)		
V	VIBRATION			VALVE, DAMPER	
W	WEIGHT, FORCE		WELL		
X	UNCLASSIFIED (*)	X-AXIS	UNCLASSIFIED (*)	TRANSDUCER	
Y	EVENT, STATE (*)	Y-AXIS		RELAY, COMPUTER	
Z	POSITION	Z-AXIS		DRIVE, ACTUATOR	

(*) WHEN USED EXPLANATION IS SHOWN ADJACENT TO INSTRUMENT SYMBOL.

PLC I/O SYMBOLS

- AI — ANALOG INPUT TO PLC
- AO — ANALOG OUTPUT FROM PLC
- DI — DIGITAL INPUT TO PLC
- DO — DIGITAL OUTPUT FROM PLC
- OIT — OPERATOR INTERFACE TERMINAL

INSTRUMENT SYMBOLS

- LOCALLY MOUNTED FIELD INSTRUMENT
- MOUNTED ON PANEL FRONT
- MOUNTED INSIDE PANEL
- ULTRASONIC
- RADAR
- FLOAT LEVEL SWITCH
- FM — FLOW METER

INSTRUMENT IDENTIFICATION

TAG NUMBER: AAA-BBB-XX-YYY

- LOCATION DESIGNATOR
- EQUIPMENT DESIGNATOR
- ISA FIRST LETTER
- INSTRUMENT/LOOP NUMBER

BBB ZZZ
XX
YYY

XX = INSTRUMENT TYPE
YYY = NUMBER
ZZZ = DESCRIPTOR:

CG	COMBUSTIBLE GAS
CH	CHLORINE
CL	CLOSE
ES	EMERGENCY STOP
FAIL	FAILURE
FOR	FOWARD
FR	FORWARD-REVERSE
HA	HAND-AUTO
HOA	HAND-OFF-AUTO
HOR	HAND-OFF-REMOTE
LCL	LOCAL
LOR	LOCAL-OFF-REMOTE
LR	LOCAL-REMOTE
OP	OPEN
O/C	OPEN-CLOSE
OL	OVERLOAD
O/C/A	OPEN-CLOSE-AUTO
O/O	ON-OFF
O/S/C	OPEN-STOP-CLOSE
pH	pH
REV	JOG-REVERSE
RUN	RUNNING
S/S	START-STOP
STR	START
STP	STOP
TURB	TURBIDITY
UVT	UV TRANSMITTANCE

MOTOR STARTER SYMBOLS

- MOTOR STARTER
- VFD — VARIABLE FREQUENCY DRIVE
- RVSS — REDUCED VOLTAGE SOLID-STATE STARTER

LINESTYLES AND INTERFACE SYMBOLS

- PROCESS LINE
- EXISTING PROCESS LINE
- ELECTRICAL SIGNAL (ANALOG)
- ELECTRICAL SIGNAL (DISCRETE)
- ELECTRICAL SIGNAL (POWER)
- SOFTWARE OR DATA LINK
- SPECIAL SIGNAL CABLE
- PNEUMATIC SIGNAL
- CABINET BOUNDARY
- EQUIPMENT OR SKID BOUNDARY
- FUTURE EQUIPMENT BOUNDARY
- DIRECTION OF FLOW
- SIGNAL CONNECTION
- CROSSOVER - NO CONNECTION

PROCESS

SERVICE DESCRIPTION
ORIGIN/ESTINATION
CONNECTOR NUMBER → NO. | P&ID NO.

INTERFACE FROM PROCESS EXTERNAL TO PROJECT

SIGNAL

SERVICE DESCRIPTION
ORIGIN/ESTINATION
CONNECTOR NUMBER → NO. | P&ID NO.

INTERFACE FROM PROCESS EXTERNAL TO PROJECT

BROKEN SIGNAL LINE
X = SAME SHEET DESTINATION NO.

CONTROL INTERLOCK

EQUIPMENT TAG NAME STRUCTURE

ID - AAA - BBB - XX Y Z

- FACILITY IDENTIFIER (WHEN APPLICABLE)
- FACILITY AREA OR SYSTEM IDENTIFIER (SEE TABLE BELOW)
- EQUIPMENT/INSTRUMENT IDENTIFIER (SEE TABLE BELOW)
- LOOP NUMBER
- UNIT NUMBER
- UNIT MODIFER (WHEN APPLICABLE)

FACILITY IDENTIFIER

IDENTIFIER (ID)	IDENTIFIER DESCRIPTION
TP1	DUCKETT CREEK TRATMENT PLANT 1
TP2	DUCKET CREEK TREATMENT PLANT 2

FACILITY AREA OR SYSTEM IDENTIFIER

IDENTIFIER (AAA)	IDENTIFIER DESCRIPTION	IDENTIFIER (AAA)	IDENTIFIER DESCRIPTION
ADM	ADMINISTRATION (CONTROL & MAINTENANCE) BUILDING	RWPS	RAS/WAS PUMP STATION
AD1, AD2	AEROBIC DIGESTER NO. 1 AND NO. 2	SSB	SLUDGE STORAGE BASIN
BLW	BLOWER AREA	SHB	SOLIDS HANDLING BUILDING
DEC	DECANTER	TLB	TRUCK LOADING BAY
FC1, FC2	FINAL CLARIFIER NO. 1 AND NO. 2	UVD	UV DISINFECTION
GAR	GARAGE AREA	WT	WASTE TANK
HW	HEADWORKS	YD	YARD PIPING
OPS	OPERATIONS BUILDING		
OD1, OD2	OXIDATION DITCH NO.1 AND NO. 2		

EQUIPMENT IDENTIFIER

IDENTIFIER (BBB)	IDENTIFIER DESCRIPTION	IDENTIFIER (BBB)	IDENTIFIER DESCRIPTION
AC	AIR COMPRESSOR	MOD	UV MODULE
AF	AIR FILTER	MS	MOTOR STARTER
AHU	AIR HANDLING UNIT	MXR	MIXER
AS	ACOUSTIC SILENCER	NER	NETWORK EQUIPMENT RACK
B	AERATION BLOWERS	NSW	NETWORK SWITCH
BV	BALL VALVE	OCF	ODOR CONTROL FAN
BFP	BELT FILTER PRESS	P	PUMP
BFV	BUTTERFLY VALVE	PAC	PACKAGED AIR CONDITIONER
BS	BAR SCREEN	PB	PUSH-BUTTON STATION
C	COMPRESSOR	PC	PERSONAL COMPUTER WORKSTATION
CAM	CAMERA	PD	PULSATION DAMPER
CC	CALIBRATION COLUMN	PDC	POWER DISTRIBUTION CABINET (UV)
CD	CONTROL DAMPER	PF	POLYMER FEEDER
CDR	CONDENSER	PHC	PHOTOCELL
CH	CHILLER	PHP	PACKAGED HEAT PUMP
CLA	CLASSIFIER (GRIT CLASSIFIER)	PLC	PROGRAMMABLE LOGIC CONTROLLER
CLO	CHLORINATOR	PLG	PLUG AND RECEPTACLE
CMP	COMPACTOR	PP	POWER PANEL
CNV	CONVEYOR	PRV	POWER ROOF VENTILATOR
CP	CONTROL PANEL	RCV	AIR RECEIVER
CST	CONTROL STATION	REG	REGULATOR
CU	CONDENSING UNIT	RO	ROTAMETER
DEH	DEHUMIDIFIER	SB	SLUDGE BLOWER
DRV	DRIVE	SCP	SCUM PUMP
DS	DISCONNECT SWITCH	SD	SMOKE DETECTOR
DVR	DIGITAL VIDEO RECORDER	SF	SUPPLY FAN
DWW	DRY WEATHER WET WELL	SLG	SLIDE GATE
EDH	ELECTRIC DUCT HEATER	SMP	SAMPLER
EF	EXHAUST FAN	SP	SUMP PUMP
EPS	EMERGENCY PULL SWITCH	SRV	SERVER
EUH	ELECTRIC UNIT HEATER	SSCP	SCREEN SYSTEM CONTROL PANEL
EWC	ELECTRIC WATER COOLER	SSL	ZERO SPEED SWITCH
EWH	ELECTRIC WALL HEATER	SSOL	SOLID STATE OVERLOAD
FCU	FAN COIL UNIT	ST	STRAINER
FOP	FIBER OPTIC PATCH PANEL	STR	COMBINATION MOTOR STARTER
FS	FINE SCREEN	SV	SOLENOID VALVE
G	GATE	SWC	SCREENING WASHER COMPACTOR
GA	GATE ACTUATOR	SWG	SWITCHGEAR
GBT	GRAVITY BELT THICKENER	T	THERMOSTAT
GEN	ENGINE GENERATOR	TCF	TUBULAR CENTRIFUGAL FAN
GR	GRINDER	TNK	TANK
GSCP	GRIT SYSTEM CONTROL PANEL	TS	THERMAL SWITCH
HST	HOIST	UPS	UNINTERRUPTIBLE POWER SUPPLY
JB	JUNCTION BOX	UVC	UV CHANNEL
LC	LIGHTING CONTACTOR	V	VALVE (ALL TYPES)
LCP	LOCAL CONTROL PANEL	VFD	VARIABLE FREQUENCY DRIVE
LP	LIGHTING PANEL	WG	ADJUSTABLE WEIR GATE
LS	LIMIT SWITCH	WH	WATER HEATER
M	MOTOR, ELECTRIC	WWW	WET WEATHER WET WELL
MAU	MAKE-UP AIR UNIT	XF	TRANSFORMER
MCC	MOTOR CONTROL CENTER		
MCV	MOTOR OPERATED CONTROL VALVE		

NOTE:

1. THIS LEGEND IS TAKEN FROM A STANDARD PROCESS LEGEND AND NOT ALL ITEMS OR EQUIPMENT AS DESIGNATED HEREON ARE USED ON THIS PROJECT.
2. SEE DRAWING P001 FOR PIPING AND VALVE SYMBOLS.
3. SOME ABBREVIATIONS MAY NOT BE USED.

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CITY OF CHATTANOOGA, TN
CONSENT DECREE PROGRAM
CITICO PUMP RELIABILITY IMPROVEMENTS

REV	DATE	REVISION DESCRIPTION
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PROJECT NO: 95307
DATE: 02/06/2017

DISC. LEAD:	DESIGNER:	CHECKER:
PMB	SDA	PMB

SHEET TITLE
PROCESS

PROCESS LEGEND
SHEET 2

SHEET D002 REV A

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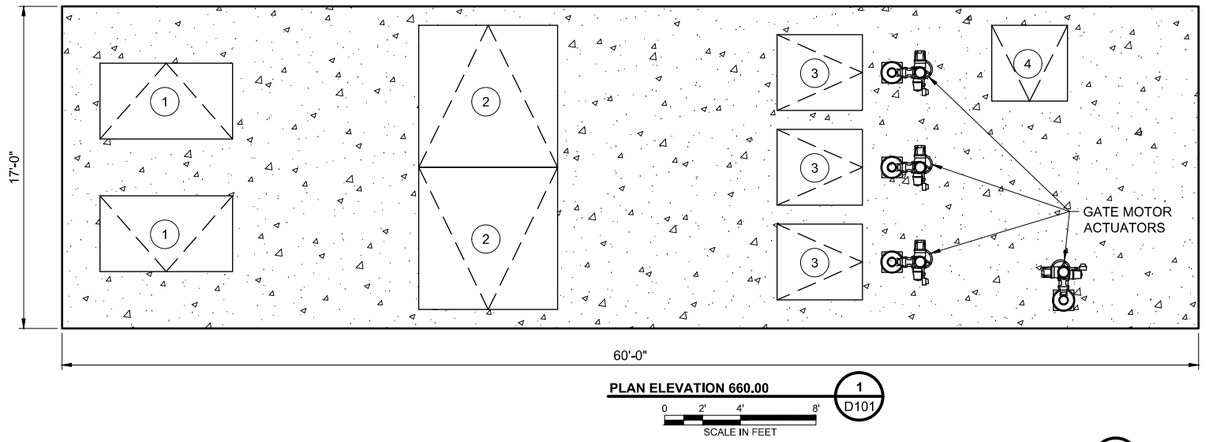


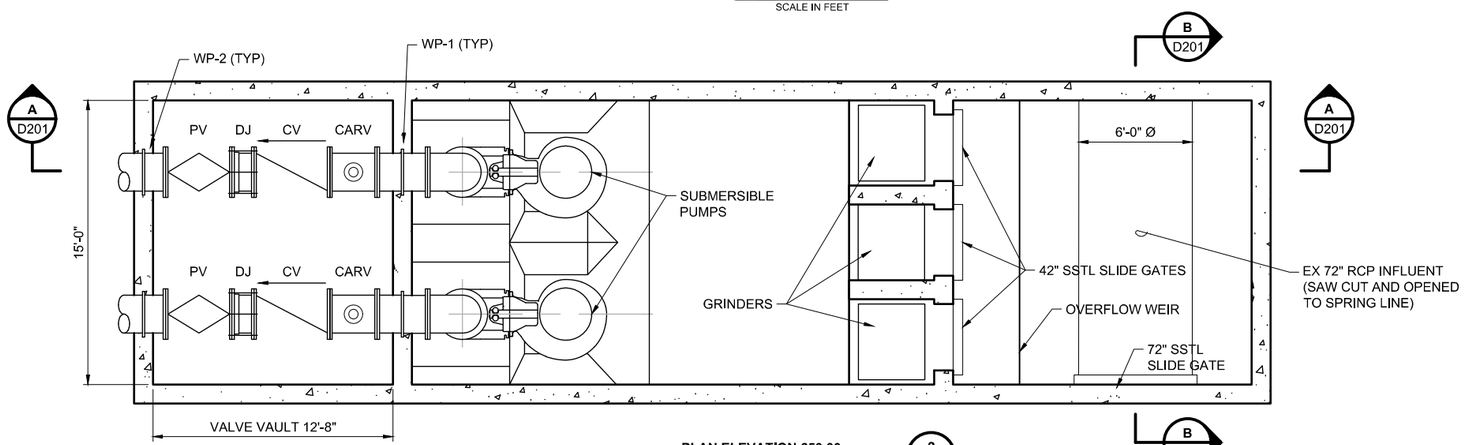
PLAN ELEVATION 660.00 — 1 / D101

0 2' 4' 8'

SCALE IN FEET

HATCH SCHEDULE

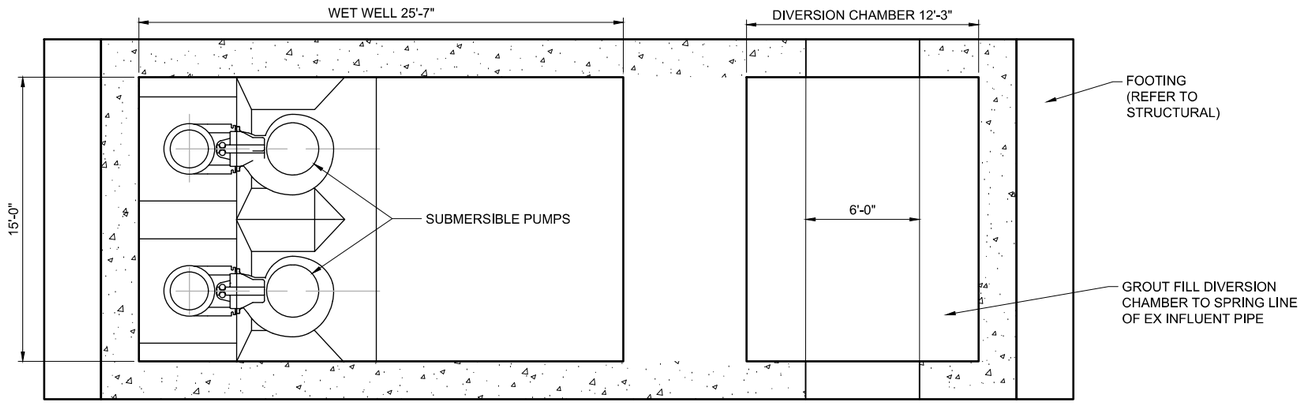
MARK	SIZE	TYPE	COUNT
1	4'-0" x 7'-0"	BILCO HS20 OR APPROVED EQUAL	2
2	7'-4" x 7'-6"	BILCO HS20 OR APPROVED EQUAL	2
3	4'-0" x 4'-6"	BILCO HS20 OR APPROVED EQUAL	3
4	4'-0" x 4'-0"	BILCO HS20 OR APPROVED EQUAL	1



PLAN ELEVATION 650.00 — 2 / D101

0 2' 4' 8'

SCALE IN FEET



PLAN ELEVATION 621.00 — 3 / D101

0 2' 4' 8'

SCALE IN FEET

PRELIMINARY - NOT FOR CONSTRUCTION

BURNS McDONNELL
3650 MANSELL ROAD, SUITE 300
ALPHARETTA, GA 30022
770-587-4776

CITICO PUMP RELIABILITY IMPROVEMENTS
CITY OF CHATTANOOGA, TN
CONSENT DECREE PROGRAM

REV	DATE	REVISION DESCRIPTION
A	2/6/17	60% REVIEW SUBMITTAL

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PROJECT NO: 95307
DATE: 02/06/2017

DISC. LEAD:	DESIGNER:	CHECKER:
PMB	SDA	PMB

SHEET TITLE
PROCESS

PUMP STATION PLANS

SHEET D101 REV A

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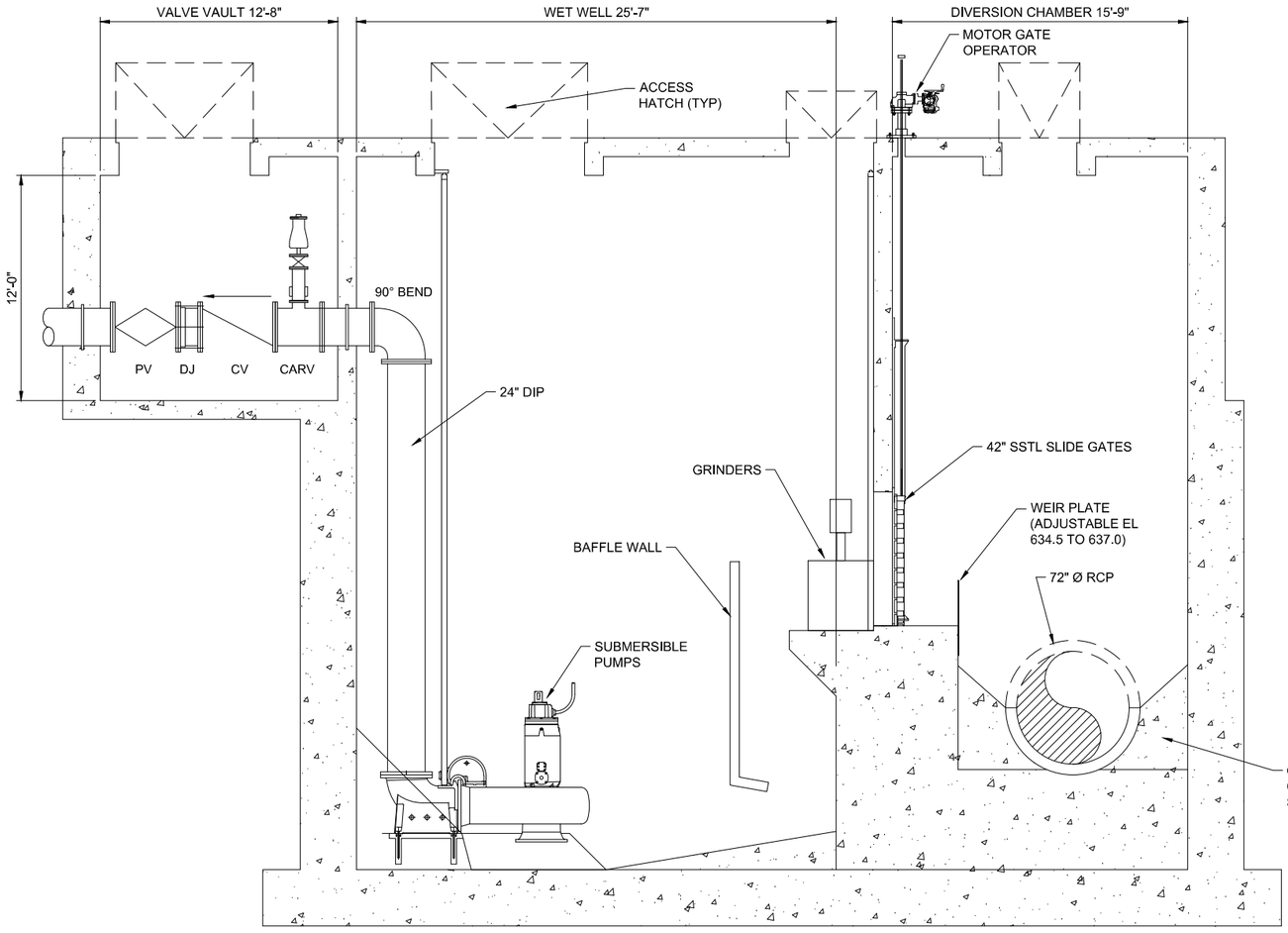
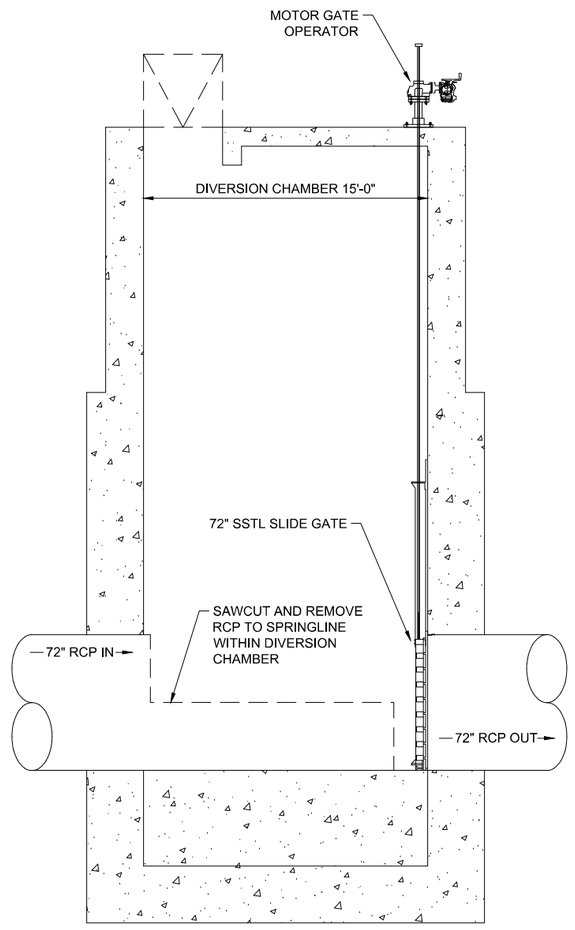


PUMP STATION SECTION A D201

0 2' 4' 8'

SCALE IN FEET



PUMP STATION SECTION B D201

0 2' 4' 8'

SCALE IN FEET

NOTES:
1. WET WELL DESIGN AND BAFFLE WALL ADHERE TO MINIMUM DIMENSIONS PER HYDRAULIC INSTITUTE STANDARD HI 9.8 FOR 22.5 MGD FLOW PER PUMP. REFER TO STRUCTURAL DRAWINGS.

PRELIMINARY - NOT FOR CONSTRUCTION

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CITICO PUMP RELIABILITY IMPROVEMENTS
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PROJECT NO: 95307
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SHEET TITLE
PROCESS

PUMP STATION SECTIONS

SHEET D201 REV A

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EBPS-PLC-060

EBPS-LIT-LI-101 (AI)
EBPS-SG-MD-003 (DO) EBPS-SG-MB-003 (DO) EBPS-SG-ZS0-003 (DI) EBPS-SG-ZSC-003 (DI) EBPS-SG-HS-003 (DI)
EBPS-SG-MD-002 (DO) EBPS-SG-MB-002 (DO) EBPS-SG-ZS0-002 (DI) EBPS-SG-ZSC-002 (DI) EBPS-SG-HS-002 (DI)
EBPS-SG-MD-001 (DO) EBPS-SG-MB-001 (DO) EBPS-SG-ZS0-001 (DI) EBPS-SG-ZSC-001 (DI) EBPS-SG-HS-001 (DI)
EBPS-SG-MD-004 (DO) EBPS-SG-MB-004 (DO) EBPS-SG-ZS0-004 (DI) EBPS-SG-ZSC-004 (DI) EBPS-SG-HS-004 (DI)
EBPS-LIT-LI-102 (AI)
EBPS-LSH-LAH-101 (DI)
EBPS-GRCP-YA-101 (DI) EBPS-GRCP-MS-101 (DI) EBPS-GRCP-HS-101 (DI) EBPS-GRCP-MD-101 (DO)
EBPS-GRCP-YA-102 (DI) EBPS-GRCP-MS-102 (DI) EBPS-GRCP-HS-102 (DI) EBPS-GRCP-MD-102 (DO)
EBPS-GRCP-YA-103 (DI) EBPS-GRCP-MS-103 (DI) EBPS-GRCP-HS-103 (DI) EBPS-GRCP-MD-103 (DO)
EBPS-LIT-LI-111 (AI)
EBPS-LSH-LAH-111 (DI) EBPS-LSL-LAL-112 (DI)
EBPS-P-SI-101 (AI) EBPS-P-SC-101 (AO) EBPS-P-MD-101 (DO) EBPS-P-HS-101 (DI) EBPS-P-MN-101 (DI) EBPS-P-YA-101 (DI)
EBPS-P-SI-102 (AI) EBPS-P-SC-102 (AO) EBPS-P-MD-102 (DO) EBPS-P-HS-102 (DI) EBPS-P-MN-102 (DI) EBPS-P-YA-102 (DI)

RAW WW CSOTF

GRINDER CONTROL PANEL EBPS-GRCP-101
ES: JI 101, HSS 101A, HS 101 (HOA)
RUN: YI 101A
STP: YI 101B
FAIL: YI 101C
RST: YS 101

GRINDER CONTROL PANEL EBPS-GRCP-102
ES: JI 102, HSS 102A, HS 102 (HOA)
RUN: YI 102A
STP: YI 102B
FAIL: YI 102C
RST: YS 102

GRINDER CONTROL PANEL EBPS-GRCP-103
ES: JI 103, HSS 103A, HS 103 (HOA)
RUN: YI 103A
STP: YI 103B
FAIL: YI 103C
RST: YS 103

VFD EBPS-VFD-101
VFD EBPS-VFD-102

CSO INLET BOX
EX CSO GATE (H)
RAW WW FROM DOWNTOWN COLLECTOR
48"
RAW WW FROM EAST COLLECTOR
72" J.BOX
72"

YIC 003, YIO 003, ZSC 003, ZSO 003, HS 003B (O/C), HS 003A (L/R)
YIC 002, YIO 002, ZSC 002, ZSO 002, HS 002B (O/C), HS 002A (L/R)
YIC 001, YIO 001, ZSC 001, ZSO 001, HS 001B (O/C), HS 001A (L/R)
YIC 004, YIO 004, ZSC 004, ZSO 004, HS 004B (O/C), HS 004A (L/R)

LIT 101
LIT 102
LSH 101
LIT 111
LSH 111
LSL 112

EBPS DIVERSION CHAMBER
WEIR WALL

EBPS-SG-001 (M) → G EBPS-GR-101
EBPS-SG-002 (M) → G EBPS-GR-102
EBPS-SG-003 (M) → G EBPS-GR-103
EBPS-SG-004 (M) 72"

EBPS GRINDER CHANNELS

EBPS-P-101
EBPS-P-102
PI 401
PI 402
SUMP

EBPS WET WELL

EBPS VALVE VAULT

RAW WW 48" WWFM TO MBWWTP
RAW WW 30" FM TO MBWWTP

EX CITICO PS
48"
30"

CITICO EBPS P&ID

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CITICO PUMP RELIABILITY IMPROVEMENTS
CITY OF CHATTANOOGA, TN
CONSENT DECREE PROGRAM

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A	2/6/17	60% REVIEW SUBMITTAL

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PROJECT NO: 95307
DATE: 02/06/2017

DISC. LEAD:	DESIGNER:	CHECKER:
PMB	SDA	PMB

SHEET TITLE
PROCESS

PIPING AND INSTRUMENTATION DIAGRAM

SHEET D601 REV A

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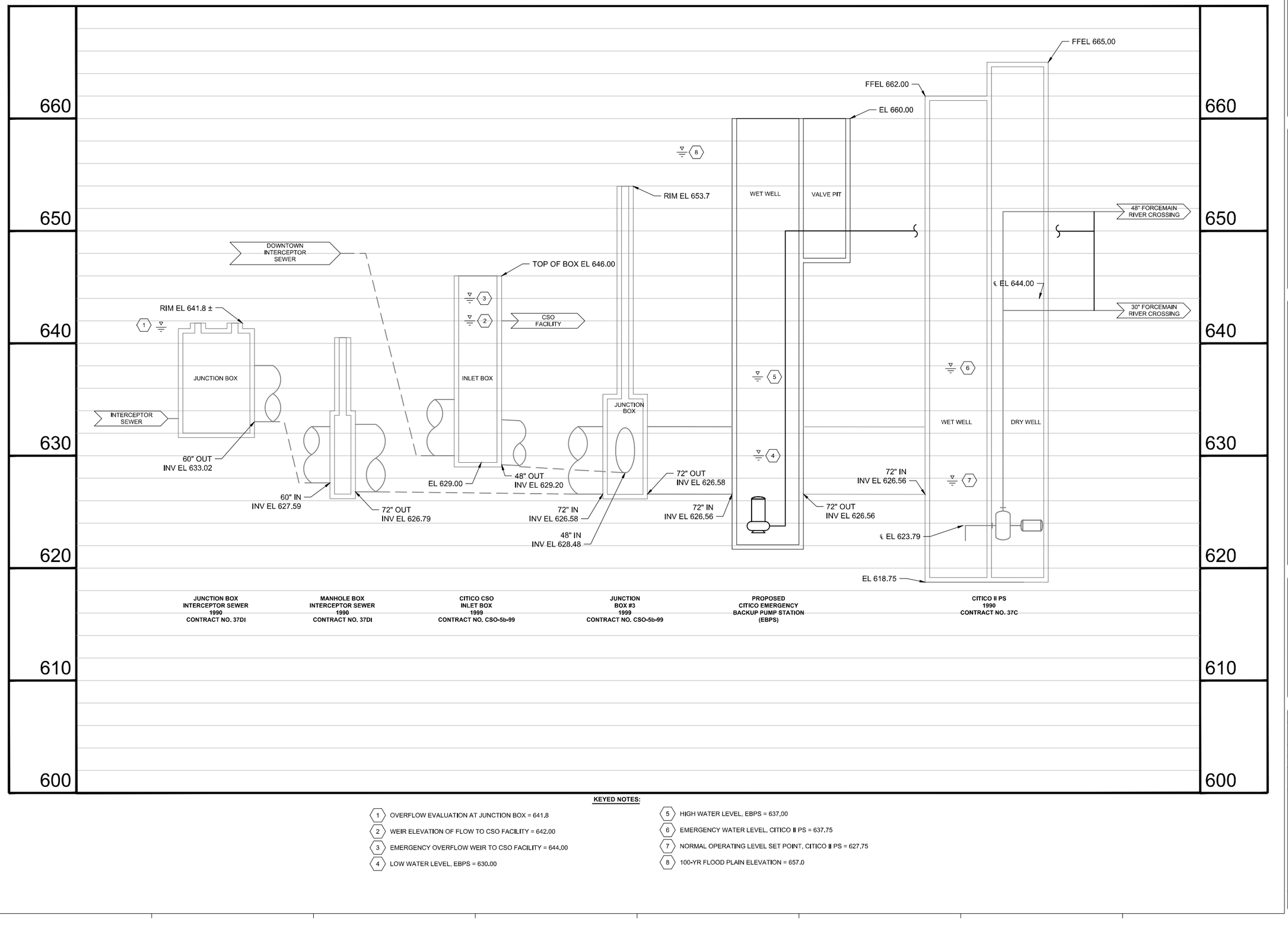

KEYED NOTES:

1. OVERFLOW EVALUATION AT JUNCTION BOX = 641.8
2. WEIR ELEVATION OF FLOW TO CSO FACILITY = 642.00
3. EMERGENCY OVERFLOW WEIR TO CSO FACILITY = 644.00
4. LOW WATER LEVEL, EBPS = 630.00
5. HIGH WATER LEVEL, EBPS = 637.00
6. EMERGENCY WATER LEVEL, CITICO II PS = 637.75
7. NORMAL OPERATING LEVEL SET POINT, CITICO II PS = 627.75
8. 100-YR FLOOD PLAIN ELEVATION = 657.0

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CITICO PUMP RELIABILITY IMPROVEMENTS
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PROJECT NO: 95307
DATE: 02/06/2017

DISC. LEAD:	DESIGNER:	CHECKER:
PMB	SDA	PMB

SHEET TITLE
PROCESS
SYSTEM PROFILE

SHEET **D801** REV **A**

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